

PROCEEDINGS OF THE LINNEAN SOCIETY OF LONDON

148th Session (1935-6)

Part 2

CONTENTS.

	Page
Ultra-rapid Photomicrography and its bearing on some biological problems. By A. G. LOWNDES, F.L.S.	54
A mid-Devonian fish fauna. By Dr. C. FORSTER COOPER	56
Experiments to counteract the effects of London Fog on plants and flowers. By Sir ARTHUR W. HILL, K.C.M.G., F.R.S., F.L.S.	60
Some Linnaean types of <i>Asclepias</i> . By Dr. A. B. RENDLE, F.R.S., F.L.S.	62
Plankton ecology and the hypothesis of animal exclusion. By Professor A. C. HARDY, F.L.S.	64
Contributions to a biography of John Ray (1627-1705). By D. C. GUNAWARDENA, M.Sc., F.L.S.	71
The marine ecology of the South African coasts, with special reference to the habits of limpets. By Prof. T. A. STEPHENSON	74
Botanical tour at the Cape. By S. GARSIDE, M.Sc., F.L.S.	79
On the distribution of the Collembola of the genus <i>Ceratrimera</i> Börner, with special reference to the Tasmanian and New Zealand species described by Sir John Lubbock in 1899. By H. WOMERSLEY, A.L.S. [Abstract.]	82
Notes on the fauna of San Cristobal Island, Solomon Islands. By R. J. A. W. LEVER, B.Sc., F.L.S.	82
Evidence that the Growth of the Dead-nettle, <i>Lamium album</i> L., is stimulated by the presence of the Stinging-nettle, <i>Urtica dioica</i> L. By Sir EDWARD B. POULTON, F.R.S., F.L.S. (Plate 1.)	83
Some further studies in Endemism. By Dr. J. C. WILLIS, F.R.S., F.L.S. [Abstract.]	86
On Hippolytid prawns of the genus <i>Ligur</i> , Sarato. By ISABELLA GORDON, D.Sc., Ph.D., F.L.S. (With 2 Text-figures.) ...	102
Some uncommon British Grasses. By C. E. HUBBARD, F.L.S.	108
Proceedings of General Meetings held on 9 January, 30 January, 6 February, 20 February, and 5 March, 1936 (including descriptions of the Exhibits shown on 5 March).	

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1936

THE LINNEAN SOCIETY OF LONDON



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PROCEEDINGS OF THE LINNEAN SOCIETY OF LONDON

148th Session (1935-6)

Part 2

GENERAL MEETINGS

9 JANUARY 1936

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 5 December 1935, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted :—Cicely Kate Ricardo, Frederick Kirkwood Makins, Hampton Wildman Parker and Noel James Gillies Smith.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Bernard William Harrison Coulson ; for the first time, in favour of Myfanwy Ellis, George Edward Trease and Thomas Ashton Lofthouse.

Issued 27 March 1936]

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Ultra-rapid Photomicrography and its bearing on some biological problems. By Mr. A. G. LOWNDES. [Abstract.]

CINEMA photomicrography can be used for two distinct purposes: (1) the filming of objects under the microscope for the purpose of projecting the films, and (2) the investigation and measurement of movements that are too rapid to be followed or even seen with the eye.

One great disadvantage of the microscope is that all movement is speeded up owing to the fact that distance is magnified but time is not, and hence the necessity of ultra-rapid exposures. To take a simple example. *Paramecium* is known to swim at a rate of 1.3 mm. per second. With a magnification of 100 diameters its image will cross the plate at a rate of 130 mm. per second. The outline of an image will, however, give a blurred effect to the unaided eye if it is more than 0.1 mm. broad, from which it is obvious that to photograph this slow-moving animal, even under a comparatively low magnification, an exposure of $1/1,300$ seconds is required. To film the cilia on this animal a much higher magnification would be required, and since the cilia are waving backwards and forwards on the moving animal it will be realized that exposures of as little as $1/30,000$ seconds are necessary. To take another example. The head appendages of such an animal as *Diaptomus gracilis* are vibrating at a rate of something of the nature of 50 complete beats per second, and so, under reasonable powers of the microscope, exposures of the order of $1/30,000$ are required.

The simplest method of obtaining such exposures is to rotate a disk between the substage of the microscope and the source of illumination and cut either one or more slots in the disk. Disks of the type required have been made, and the slots are adjustable so that they may subtend an angle of one degree or even less.

If such a disk is made to rotate at a speed of 100 revs. per second and the slot subtends an angle of one degree the exposure will be $1/36,000$ seconds, and this is an exposure which is frequently used. Of course the source of illumination must be a strong one, and in practice an arc-light taking about 20 amps. is used. Matters are easily so arranged that each frame of film in the cinema camera attached to the microscope can receive either a single ultra-rapid exposure (strobograph) or several (polygraph).

Using the above method, it is quite easy to photograph such things as cilia or crustacean appendages during normal movement, though probably the most interesting application is the measurement of the rate at which a wave passes either

up or down a single flagellum such as that of *Peranema* or *Euglena*. One great advantage of the method is the extremely low cost of film and the relatively low cost of the whole apparatus.

For irregular or spontaneous movements such as those of the swimming-feet of calanoid copepods the twin camera is a great asset. In the single film camera the film is, of course, stopping 20 times per second if 20 exposures per second is the rate used, but the actual time of exposure is $1/40$ second only, while the other $1/40$ is taken up with the cut-off, during which time the film is not exposed. Now it is obvious that a spasmodic leap may take place during cut-off instead of during exposure, and the critical instant is then lost. To obviate this two films are used working together and arranged so that one film is ready for exposure while the other is at cut-off, and either the polygraphic or strobographic method of exposures can be used in conjunction with this arrangement.

This method is particularly useful for filming single cilia, where the effective beat is quite slow while parts of the recovery beat are quite rapid.

Mr. D. J. SCOURFIELD said that he had been very pleased to listen to Mr. Lowndes's paper, because the subject of the movements of cilia and flagella was one in which he had been interested for a long time. Nearly thirty years ago he had employed a simple stroboscopic apparatus for viewing such movements, although he had not taken any photographs with it. It consisted essentially of a revolving aluminium disk, about 13 inches in diameter, very similar to the one exhibited that evening by Mr. Lowndes, but it was used in a rather different way. It was used definitely as a stroboscope, to obtain apparently slowly moving views of quickly moving objects, and not simply as a means of getting very rapid pictures of the same. Instead of running at a very high speed endeavour was made to get closely into time with the beating of the cilia, and in order to secure the extremely short flashes of light necessary for sharp definition the single slot in the disk was cut down to one-hundredth of an inch. This meant that the duration of the flash on the object was only about one four-thousandth of a second for each revolution per second of the disk. As it was found that the disk had to rotate some sixteen times a second in the case of some ciliates, in order to keep in time with the beating of their cilia, the actual duration of each light-flash was only about one sixty-thousandth of a second, an even shorter period than that used by Mr. Lowndes. In the case of rotifers it was found that to keep in time with their cilia only seven to ten revolutions of the disk per second were required, but at this speed the

view was, of course, marred by a bad flicker. From the facts that Mr. Lowndes's photographs of the flagellum of *Peranema* were taken at intervals of one-fiftieth of a second, and that it required apparently seven pictures to complete one movement, it could be inferred that the wave motion along the flagellum was comparatively slow, namely, about one-seventh of a second. There was one point Mr. Scourfield said he would particularly like to emphasize in connection with the movements of flagella, and that was that they were by no means all alike. There were certainly flagella and flagella. In some forms the wave motion had very little amplitude—so little, in fact, that the only difference in appearance between the flagellum in motion and at rest was that the former appeared a little thicker than the latter. On the other hand, in many forms the flagellum was traversed by very big waves, not always in one plane, and Mr. Lowndes's photographs seemed to show clearly that this was true at any rate of the flagellum of *Euglena*. He thought Mr. Lowndes had been very successful in obtaining a most valuable series of photographs and in demonstrating a number of new points.

Prof. E. W. MACBRIDE and Prof. W. GARSTANG also spoke, and Mr. Lowndes replied.

A mid-Devonian fish fauna.

By Dr. C. FORSTER COOPER (Visitor). [Abstract.]

THE mid-Devonian quarry at Achanarras in Caithness was first worked for stone in 1870, and its fauna subsequently examined by the late Doctor Traquair in 1890 and 1893, when he described some fifteen different species of palaeozoic fishes.

As the result of five seasons' work from 1931 to 1935 only a few additions and emendations have been made, and with these Traquair's list may be taken to represent the fauna of this part of 'Lake Orcady' fairly accurately.

The 'fish band' outcrops at the top of a small hill at Achanarras and the fossil strata are about 8 feet in thickness, and dip one in twelve to the east. The upper layers, just underlying the heather turf, are much decayed, and have yielded only poor specimens of *Coccosteus*, *Dipterus* and an occasional *Glyptolepis*. Below this is a section marked chiefly by *Glyptolepis*, but otherwise without much of interest. Towards the middle of the series is a layer with numerous specimens of *Palaeospondylus* and the small acanthodian *Mesacanthus peachi*. At the bottom of the 8 feet is a remarkable band, about 6 inches in depth, in which *Dipterus valenciennesi* occurs in the greatest abundance, to the exclusion of any other form except a few *Pterichthyodes*. The appearance here

is as though some cataclysm had destroyed all life with great suddenness. This layer forms the only well-marked zone in the series and is the lower limit of the fish band. Below it the character of the stone alters, and no signs of vertebrate life are to be found.

The strata are characterized by the great number of specimens and by the good state, on the whole, of their preservation. A further striking point is an apparent total absence of invertebrate life and the rarity of plant-remains. Although with the exception of the ptyctodont *Rhamphodopsis* and an obscure form, as yet unnamed, little new has been added to Traquair's list, it is the quantity of certain of the species which is yielding valuable information. The small acanthodian *Mesacanthus peachi*, for instance, has been collected in a series of several hundreds, including young and immature forms as well as adults. From these measurements have been made which prove that the growth of the spines and their position relative to the head is isogonic, and that from these proportions information is obtained whereby this form can be distinguished from other allied species.

A large series of the dipnoan fishes *Dipterus valenciennesi* and *D. platycephalus* throws much light both on the structure of the head, which hitherto has been insufficiently known, and on the composition of the scales. The result is to show the probability of these two forms being representatives not of two species but alternating phases during the life of a single species.

The bulk of the collections is as yet not developed nor fully examined. The matrix is very hard and resistant, and is best attacked by treatment with hydrofluoric acid, a satisfactory but very slow process which yields a considerable amount of fine detail in spite of the crushing that the specimens have undergone. It is hoped that the large series of *Pterichthyodes*, when finally developed and examined, will do much to throw light on several problems, at present little understood, of growth, specific characters and anatomy.

Sir A. SMITH WOODWARD thought that Dr. Forster Cooper was to be congratulated on the thoroughness of his exploration of the bed of fossil fishes at Achanarras. As the specimens were crushed and often distorted, a large collection was needed to determine satisfactorily the specific characters of the forms represented. In studying the osteology he thought much help might be obtained from the fragments of the same fishes which were scattered over the flagstones in other localities near Thurso. The modern improved methods of preparing and examining such fossils made it desirable to collect again in all the old classic localities.

Dr. T. S. WESTOLL said that Dr. Forster Cooper deserved our best thanks for bringing together such a magnificent collection of material, not only for the ecological results, but also for the help such a collection gives to the study of comparative anatomy. In the case of the primitive bony fishes the detailed structure of the skull shows very considerable variation, which is often of systematic importance. The study of such variation demands a very large number of specimens of the same species from a single horizon, and Dr. Forster Cooper's collection of *Dipterus* fulfils these conditions, and the investigation has already produced very interesting results.

The differences in the 'species' of *Dipterus* mentioned by Dr. Forster Cooper are of great interest. '*D. platycephalus*' has cosmine on the scales and head-bones, and a cosmine covered snout, not found in *D. valenciennesi*, which is otherwise identical. There are a few specimens with the cosmine partly removed; the relics have well-rounded margins, and in such specimens there is not always an ossified snout. The range of variation is well explained by periodical resorption (partial or complete) of the cosmine, followed by redeposition. A similar explanation can be applied to certain genera of rhipidistian Crossopterygii, which appear to lose their cosmine on occasion; the cosmine-free fishes are usually placed in different 'genera'. It can be shown that such a resorption process allows the growth of an Osteolepid snout to be explained; this consists of a series of separate bones fixed together by a continuous external sheet of cosmine. Theoretical considerations suggest that the resorption, and therefore probably the growth, was periodical in nature, and this conclusion is in agreement with some views on the origin of Middle O.R.S. sediments. These results were derived originally from studies carried out on Dr. Forster Cooper's collection of *Dipterus*.

One impressive feature of Dr. Forster Cooper's work on these fishes is the skill which he has applied to the preparation, and particularly to the photography, of the material.

Mr. D. J. SCOURFIELD said that he was not quite certain from what Dr. Forster Cooper had told them whether the method of dissolving away the matrix from the fossils had been carried to the stage in which all the matrix had been removed, but he might mention that in the case of a puzzling fossil at which he was working one specimen had been treated by Prof. Walton of Glasgow, who had been able entirely to get rid of the matrix and to transfer the fossil to a film of cellulose.

Prof. D. M. S. WATSON, Dr. ERROL I. WHITE, Prof. W. GARSTANG and the PRESIDENT also spoke, and Dr. Forster Cooper replied.

30 JANUARY 1936

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 9 January 1936, having been circulated, were taken as read and confirmed.

The President then read from the Chair the following Loyal Addresses, which had been prepared by the Officers and approved by the Council. These were unanimously adopted, all present rising from their seats :—

To The King's Most Excellent Majesty

THE HUMBLE ADDRESS OF THE PRESIDENT,
COUNCIL, AND FELLOWS OF THE LINNEAN
SOCIETY OF LONDON

Most Gracious Sovereign,

WE, Your Majesty's most dutiful and loyal subjects, the President, Council, and Fellows of The Linnean Society of London in General Meeting assembled, humbly beg leave to offer our deepest and most heartfelt sympathy with Your Majesty in the great sorrow that has befallen You in the death of Your well beloved Father, our late Sovereign Lord, King George the Fifth. Your Majesty's loss is felt not only throughout the Empire, but by the whole world.

While thus expressing our sorrow, we ask leave, Sire, at the same time to tender to Your Majesty our unfeigned and loyal homage upon Your Majesty's accession to the Throne of Your Ancestors.

The sympathetic interest, which Your Majesty has constantly manifested in all that concerns the progress of Science and its applications to human life, encourages us to hope that Your Majesty will be graciously pleased to continue to our Corporate Body that beneficent Patronage which it has continuously enjoyed at the Hands of Your Majesty's Royal Predecessors since the granting of our Charter in 1802.

That Your Majesty's Reign over a loyal, grateful, and loving people may be long and glorious, is our earnest wish and ardent prayer.

Given under the Common Seal of the Society, this thirtieth day of January in the year one thousand nine hundred and thirty-six.

W. T. CALMAN, *President.*

L.S.

J. RAMSBOTTOM,
STANLEY KEMP, } *Secretaries.*

To Her Most Excellent Majesty
Queen Mary

THE HUMBLE ADDRESS OF THE PRESIDENT,
COUNCIL, AND FELLOWS OF THE LINNEAN
SOCIETY OF LONDON

Madam,

WE, the President, Council, and Fellows of The Linnean Society of London, in General Meeting assembled, remembering with heartfelt pride the high distinction which your Majesty conferred upon our Society in graciously consenting to become one of our Honorary Members, beg leave humbly to offer our profound and heartfelt sympathy with Your Majesty in the great and irreparable loss that has befallen You, the Royal House, and the Empire, in the death of our Beloved and Venerated Sovereign Lord, King George the Fifth, our Patron, Whose Memory will ever be faithfully cherished by a grateful people.

Given under the Common Seal of the Society, this thirtieth day of January in the year one thousand nine hundred and thirty-six.

W. T. CALMAN, *President.*

L.S.

J. RAMSBOTTOM,
STANLEY KEMP, } *Secretaries.*

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted:—Godfrey Michael Graham.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time, in favour of Myfanwy Ellis, George Edward Trease and Thomas Ashton Lofthouse.

Experiments to counteract the effects of London Fog on plants and flowers. By Sir ARTHUR W. HILL, K.C.M.G., F.R.S.

OWING to the severe damage caused by London fogs to Orchid flowers, Begonias and other plants at Kew, experiments

have been carried out at Kew during the past two months with (1) ammonia, (2) electric-fans. Ammonia 2 per cent. solution was placed in trays on the floor of the house where Begonias—'Gloire de Lorraine', &c.—were in flower, with the object of neutralizing the sulphuric acid present in the fogs, and very little shedding of flowers or leaves took place beyond what is normal at this season. Electric-fans were installed in the tropical Begonia and tropical Orchid Houses, and proved quite successful during the bad fogs in December 1935. *Calanthe* flowers remained uninjured, whereas in an adjoining similar house without fans all the flower spikes were seriously damaged.

During the bad fogs in mid-January, however, when snow fell at the same time, the fans were not so effective, and it seems probable that the humidity of the houses was unduly high at the time and the fans ceased to lower the humidity, so that the injurious matters in the fog were able to be effective. It seems clear from the experiments carried out so far that the fog damage is closely linked with temperature and moisture conditions, and immunity can be effected only by careful adjustment of these two factors.

Specimens of *Calanthe* inflorescences were shown, some entirely blackened and wholly spoilt, others with the older buds injured, and others less advanced at the time of the January fog which were fairly normal.

Dr. C. R. METCALFE (Visitor) said that microscopical examination shows that when leaves of Begonias and other plants fall off during foggy weather the petioles sometimes break where an absciss layer is present, but in other instances an irregular fracture occurs. No evidence has been found that foggy weather stimulates the formation of absciss layers. Granular material, which stains readily with alkannin, tends to accumulate at the points where the leaves break off. The experiments conducted so far seem to indicate that the most likely way to prevent damage during foggy weather is by a careful adjustment of the temperature and humidity of the houses.

Mr. J. RAMSBOTTOM suggested that some information might be got by noting the effect of temperature on orchid seedlings in culture flasks. Here the humidity is more or less constant. The appearance of the specimens exhibited recalled to mind the effect of an accidental drop in the temperature of the orchid houses, when all the seedlings would show drooping and discoloured leaves.

Dr. E. J. COLLINS referred to observations which he had made of the effect of hydrocyanic acid gas on plants. This

gas was used to combat the white fly pest of greenhouse plants, but its use entailed some risk of damage to the plants, e.g., dropping flowers, scorched leaves and injury to the young growth. With suitable precautions this risk was lessened and the gas might be rendered innocuous to plant life, although this depended largely on the species of plant subjected to exposure to the gas. The precaution taken was to keep the plants, the foliage particularly, in a dry condition. After an early watering of the plants no subsequent watering of the floor or staging of the greenhouse or syringing of the plants was made, while a buoyant atmosphere and a moderate temperature were maintained at sundown when fumigation was effected. When these conditions were fulfilled little damage, if any, resulted, and it was assumed that the gas did not deposit upon the foliage or penetrate into the plant tissues to any dangerous degree.

It might be added that the plants on shelving immediately under the glass were removed to lower staging because the foliage of plants in this position was invariably damaged. Here it was thought that with a falling temperature without, the humidity of the atmosphere in the vicinity of the glass increased, and with the lack of air movement enforced by the closing down of normal ventilation reached saturation point and deposited on the leaf surfaces. This was a condition which favoured damage by the gas. Dr. Collins thought that these observations confirmed the opinion that temperature and humidity were critical factors in fog damage to plants, assuming the presence of sulphuric acid in the atmosphere.

Mr. A. J. WILMOTT recalled his experiences in winter with *Elodea*, in the course of experiments by the bubbling method on its assimilation. During very dull weather it was sometimes impossible to obtain bubbles at all, and at other times bubbles came in rushes alternating with stoppages. It was presumed that the light caused so little assimilation that the oxygen in the air-channels was used up in respiration until a film of water formed across the channel. Possibly in land plants also in very damp weather there may be some similar effect when the light is insufficient to maintain normal assimilation.

Prof. F. E. WEISS also spoke.

Some Linnaean types of *Asclepias*.

By Dr. A. B. RENDLE, F.R.S.

SPECIES of *Asclepias* described in the 'Species Plantarum', p. 215, afford an instance of the relation between the Linnaean and other contemporary herbaria and the Linnaean descriptions.

6. *Asclepias variegata* foliis ovatis rugosis nudis, caule simplici, umbellis subsessilibus : pedicellis tomentosis.

Apocynum americanum erectum &c. *Pluk. alm.* 34. t. 77. f. 1.

Apocynum vetus americanum, wisank. *Dill. elth.* 32.

Habitat in America boreali.

There is no specimen in the Linnaean herbarium so named, but there is a specimen under the next species, *A. nivea*, labelled by Linnaeus '6. nivea K' (K indicating that he received it from Kalm) and written up in pencil by Smith *variegata*?, which agrees with the figure of Plukenet cited by Linnaeus under *variegata*. This is the North American plant generally known as *Asclepias variegata* characterized by ovate leaves as indicated in the Linnaean description. Plukenet's specimen is in his herbarium in Herb. Sloane (vol. 95, fol. 57) (a photograph was shown): the umbel is young and subsessile, which doubtless accounts for Linnaeus's description 'umbellis subsessilibus'.

What is the type of *A. variegata*? It cannot be the Linnaean specimen, since Linnaeus wrote it up *A. nivea*; it is, therefore, the Plukenet specimen, which agrees with Linnaeus's description. The second reference, 'Dill. elth. 32', does not help; it is a mere reference of Dillenius's under a species of his own. Presumably the plant Linnaeus had in mind when naming the species was that represented by the figure in Plukenet: he had not seen the specimen in Plukenet's herbarium.

7. *Asclepias nivea* foliis lanceolatis glabris, caule simplici, umbellis erectis lateralibus solitariis.

Asclepias caule erecto simplici annuo, foliis lanceolatis-ovatis, glabris &c. *Gron. virg.* 27.

Apocynum persicariae mitis folio, corniculis lacteis. *Dill. elth.* 33. t. 29. f. 32.

Apocynum americanum, foliis amygdali longioribus. *Plum. spec.* 2.

Habitat in Virginia et America calidiore.

The plant generally known as *Asclepias nivea*, a West Indian and tropical American species characterized by lanceolate leaves as described by Linnaeus, is not represented in the herbarium; there is no no. 7. What then is the type of *A. nivea*? Obviously not Kalm's specimen indicated by Linnaeus as no. 6 *nivea*, which does not agree with the description, the leaves being ovate and rugose, not lanceolate.

A number of Linnaeus's specimens are typified by Gronovius's herbarium now at the British Museum, and the first reference of Linnaeus is to a Gronovian plant, of which I show a photograph, which is obviously *A. variegata*, and is so written up

by John Torrey. It accounts for the habitat Virginia cited by Linnaeus.

The next reference, Dill. elth. 33. t. 29, f. 32, gives an excellent figure of the plant generally known as *A. nivea*. Unfortunately, according to Druce and Vines ('The Dillenian Herbaria') there is no specimen in the Dillenian herbarium at Oxford. The reference to Plumier is also a good figure of *A. nivea*. I suggest that the figure and description of Dillenius should be regarded as the type. It is presumably the plant Linnaeus had in mind when describing his species.

The two following species, *A. incarnata* and *A. curassavica*, are represented in the herbarium by specimens bearing Linnaeus's handwriting, which were in the herbarium at the date of publication of the 'Species Plantarum', 1753, and agree with his descriptions. Both species were previously described by Linnaeus in his 'Hortus Cliffortianus' (1737), which antedated his binary system of nomenclature, and there are corresponding specimens in Clifford's herbarium, now at the British Museum—it was bought by Banks in 1791. But as the labels in this herbarium are rarely in Linnaeus's hand, the specimens must give place as types to those in his own herbarium. Of the several hundred sheets only about eight bear his handwriting.

By a rare misprint *A. curassavica* is indicated in Dr. Jackson's 'Index to the Linnean Herbarium' by the figure 4. This is a misprint for 1, as the name occurs in the first enumeration (1753). The other two enumerations are of dates 1755 and 1767; there is no fourth list. The association between the herbarium and the 'Species Plantarum' is very definite in this species. The description reads 'umbellis erectis solitariis', which corresponds to the specimen, a poor one, with a single umbel. The Hort. Cliff. specimen is much more complete, and bears several axillary umbels, corresponding with the description 'umbellis alternis', Hort. Cliff. 78. But Linnaeus had not this specimen before him when he wrote the 'Species'.

Plankton ecology and the hypothesis of animal exclusion.

By Professor A. C. HARDY.

THE problem here discussed concerns the ecological relations between the plant and animal plankton and the vertical migrations of the latter. It arose in the consideration of the results of a plankton survey of the whaling grounds at South Georgia (Hardy and Gunther, 1935) carried out during the *Discovery* investigations under the leadership of Dr. Stanley Kemp.

In March 1926 and December-January 1926-7 the distribution of both Blue and Fin whales was shown to be closely correlated with that of their food *Euphausia superba*. Temperature and salinity did not appear to explain the Euphausian distribution, which was found to lie away from the areas of greater phytoplankton production. Herring have been shown to avoid areas of dense phytoplankton (Pearcey, 1885; Hardy, 1926; Savage, 1930; Savage and Hardy, 1935), and on a number of occasions planktologists have drawn attention to zooplankton also being scarce in such regions (Castracane, 1885; Pearcey, 1885; Herdman, 1888, 1894; Herdman and Scott, 1908; Bullen, 1908; Fish, 1925). In the South Georgia survey the finest mesh nets were used for sampling the phytoplankton, and very coarse mesh nets for the larger zooplankton; these coarse nets could not be clogged by the phytoplankton, so that a reduction in the numbers of the five more important macroplankton animals which was observed in the areas of densest phytoplankton could not be attributed to the reduced filtration of the nets. These animals were also found in small numbers in the regions of very poor phytoplankton (possibly due to shortage of food).

The values for the average phosphate contents of the water from 50 m. to the surface at stations in the 1926-7 survey were shown to be inversely correlated with phytoplankton production, a contour chart of the former being approximately the negative image of the latter. Since the distribution of the whales was shown to be positively correlated with that of *Euphausia superba*, it seemed possible that if the inverse correlation between these Euphausians and the phytoplankton was generally true then it should be possible in subsequent seasons to deduce the distribution of the whales direct from charts of phosphate values. For three later South Georgia surveys and one from the South Shetlands the phosphate analyses were available, and the distribution of the Blue and Fin whales known from the reports by Kemp and Bennett (1932) based on the whale fishery returns. In each season a remarkably close agreement was found between the distribution of the two species of whales and the phosphates, the whales always being found *away* from the regions of lower phosphate values. That the low phosphate values did reflect plant production was clearly shown by considering the distribution of pH values. The areas of increased alkalinity (due to greater carbon assimilation) invariably corresponded with the areas of reduced phosphates. It was then possible to test the inverse phytoplankton-Euphausian relationship by a deduction in the opposite direction. In February 1928 the whale concentration was at the opposite side of South Georgia to that in 1926-7; no phosphate figures were available,

but phytoplankton samples, as yet unestimated, were stored in the *Discovery* collections. If the relationship held, then, when analysed, they also should show a distribution opposite to that of the 1926-7 phytoplankton. Dr. Kemp kindly had their quantities estimated, and the prediction was found to be correct. These results and the argument which follows will be found set out in detail in Part V of the report (Hardy and Gunther, 1935) already referred to.

The relative reduction in phosphate in Antarctic waters (where the phosphates are so rich as never to be exhausted by the plants) appears to be a better index in studying the zoo-phytoplankton relationship than the phytoplankton itself, since it reflects plant production over some little time in the past and also because measurements of phytoplankton by either volume or number of cells is far from satisfactory. All plankton animals taken in the 1926-7 survey in sufficient numbers were now tabulated against ranges of phosphate values, and all show on an average reduced numbers in the regions of low phosphate (rich phytoplankton), except three copepods, which appear to be unaffected in their distribution by the plants, and three animals (two copepods and one mysid) which appear 'to prefer' regions of higher phytoplankton concentration. These results are confirmed from different series of net samples treated in different ways: day and night stations, shallow-water and deep-water stations, taken separately and together. This reduction in numbers in regions of low phosphate (rich phytoplankton) is shown to apply to animals belonging to such widely different groups as Foraminifera, Radiolaria, Polychaeta, Crustacea, Mollusca, Tunicata, and Fish. The exceptions cited will be referred to presently.

Harvey (1934, and, with collaborators, 1935) has recently found an inverse relationship between the zooplankton and phytoplankton in the Plymouth area, and attributes it to the grazing action of the former on the latter (as did Castracane, 1885). The two conceptions, grazing by the animals and some excluding influence of the plants, are not antagonistic; the former must be an important factor and may be the dominant one in areas where the phytoplankton is not very dense, but there are reasons for believing that it cannot always be the more important. The dense areas of plant production met with in the Antarctic, and at times in the North Sea, would seem to be associated with hydrological conditions such as the meeting and mixing of current systems. The southern North Sea herring in the late autumn are no longer feeding (Hardy, 1924; Savage, 1931), and so are likely to be avoiding the actual phytoplankton rather than leaving such areas because of a dearth of zooplankton in them. But more important appears to be the fact that so many different

species of plankton animals, including both herbivores and carnivores, and those which are abundant and those which are scarcer, all show a diminution in numbers in the low phosphate (high phytoplankton) regions. If grazing was the only factor one would expect that the dominant herbivores would alone control the phytoplankton and that the scarcer species would have no distributional relation to it. It is possible that the one species *Euphausia superba*, perhaps ecologically the dominant species in the Antarctic, may do so; but if so, then the distribution of the other species must be controlled in part by the areas of denser phytoplankton left by the Euphausians.

The plankton animals have not the power to migrate horizontally, but they can migrate vertically. Plant production is heavy only in the upper photic zones. If the plants should produce an uncongenial (presumably chemical) environment then the animals could escape it by going below, and, since different water layers are nearly always travelling at different speeds, would be carried out of the noxious zone. Pearcey (1885) first spoke of the 'exclusive power of the diatoms'. In the present communication the author wishes to summarize the *hypothesis of animal exclusion*, which he tentatively puts forward to explain the general inverse zoo-phytoplankton distributional relationship by linking it with the phenomenon of vertical migration which is found in so many different groups of plankton animals. The direct excluding effect is considered to be one in a vertical rather than a horizontal plane, the exclusion effect seen in plan being secondarily produced by water movements. The hypothesis may be briefly stated thus: vertically migrating animals which live for part of the twenty-four hours below the phytoplankton zone come up into that zone for a period inversely proportional to the density of the phytoplankton. The extent of the exclusion from the phytoplankton zone may vary for different species or for different stages in the development of the same species of animal.

The following observations would appear to support the hypothesis. In the South Georgia 1926-7 survey all the animals that show diminution in numbers in low phosphate (rich phytoplankton) regions all* have a marked diurnal vertical migration. The only animals which show no distributional relationship to the phytoplankton (the copepods *Calanus acutus*, *Rhincalanus gigas* and *Oithona frigida*) are the only animals which show no vertical migration, and they inhabit the layers below the phytoplankton zone. Two of the three animals which occur in larger numbers in the richer

* Except Protozoa, not studied.

phytoplankton regions are the copepods *Calanus simillimus* and *Drepanopus pectinatus*, which have a vertical migration but remain much longer in the phytoplankton zone than do any other species, and do not migrate so deeply away from it as do most other species. Regarding the third animal in this group, *Antarctomysis maxima*, insufficient is known of its vertical movements. Herdman (1907) shows repeated instances of inverse vertical distribution between phytoplankton and Copepoda. Russell (1927, 1928, 1930, 1933) at Plymouth finds that a number of different organisms, *Calanus*, *Tomopteris*, *Sagitta* and young fish which migrate away from the upper layers in daylight in spring and early summer may be found near the surface in bright sunlight in July, August and September. This is the period when the summer phytoplankton is usually at a minimum. He attributes the difference in behaviour in *Calanus* to physiological differences between the summer and spring broods; yet Nicholls (1933) and Marshall, Nicholls and Orr (1934) in the Clyde area have found *Calanus* in the upper layers in daytime in May, and they show elsewhere in their papers that the phytoplankton at this time was unexpectedly slight. In the 1926-7 South Georgia survey there is evidence, suggestive rather than conclusive, that the zooplankton does remain higher in the water in the daytime in regions of poorer phytoplankton.

No satisfactory explanation appears to have been given to account for diurnal vertical migration (one of the commonest of planktonic phenomena) in terms of advantage to the animal. Invariably the animals move upwards into the phytoplankton zone at night or at the approach of darkness, and go downwards at the approach of daylight. They no doubt react in part to the stimulus of light; the phototropisms of planktonic animals have long been established. But it is also known that the sign of the tropism may be changed under different conditions. Loeb (1906), for example, showed that Copepoda became positively phototropic by reducing the alkalinity (pH) of the environment. The diurnal changes in the pH of the upper layers, due to the daytime carbon assimilation of the plants, do not appear to be large enough to be a controlling factor in diurnal vertical migration; it is also doubtful whether the differences in pH in the upper layers between the zones of rich and poor phytoplankton are sufficient in themselves to bring about a modification of the vertical migration. The herbivores presumably come into the upper layers to feed on the phytoplankton, and the carnivores in turn to prey upon them. There is a marked difference chemically between the upper phytoplankton zones and the lower layers from which the animals migrate, particularly in respect to pH and oxygen. It seems likely that these

animals find conditions of living more suited to them down below than in the upper phytoplankton zones, and that they only make diurnal excursions into the upper zones for feeding for usually a comparatively short time. If conditions were just as suitable for them in the upper zones, wherein is their food, one would expect them to remain there instead of sinking and expending so much energy in climbing each day towards the surface. If conditions there were not as congenial to them as below it would seem likely that they would remain up for just so long as is necessary to obtain sufficient food, i.e., a shorter time when the phytoplankton is rich than when it is poor. It might be so poor that they would have to remain up all day to get sufficient food, but at the same time the adverse conditions set up by the plants would be correspondingly diminished. It is well known that the younger stages of planktonic animals are almost invariably to be found higher in the water than the older ones; perhaps because during growth they require a more constant supply of food. Clarke (1932) provides important experimental evidence, which seems to support this view, from his study of the freshwater *Daphnia*. After showing that the young 'almost always exhibit a strong positive phototropism which becomes progressively weaker as the animals grow older', he writes: 'if the culture medium is allowed to "run out" or become too dilute, it is found that the majority of adult *Daphnia* exhibit a positive phototropism, whereas when the culture medium is fresh and rich most of the animals are primarily negative to light'.

If the younger animals remain higher in the water than the adults, then, according to our hypothesis, they should not show the same tendency to be carried out of the denser phytoplankton zones as would the older forms. Wimpenny (1935), describing work in the southern North Sea, writes:

'In both 1933 and 1934 there was a tendency for the autumn herring shoals (as revealed by charted catches) to mass against the edge of a diatom patch. A similar orientation was observed when some of the zooplankton organisms caught by the Hensen net were charted. Zooplankton are not absent even in dense phytoplankton patches, but in these areas the community consists of a greater proportion of young forms.'

Professor MacBride has told me that in rearing Echinoderm larvae he has found that if the diatoms (*Nitzschia*) used as food multiply too rapidly and form a dense culture then the larvae die. My colleague, Mr. C. E. Lucas, has begun a series of laboratory experiments with cultures of zooplankton and phytoplankton which are showing promise of interesting results,

and it is hoped that experiments in the field will shortly be undertaken.

In Part V of the report by Hardy and Gunther (1935) the author shows by a series of propositions how plankton animals, provided they migrate more deeply or remain down longer in relation to the density of the phytoplankton, will be distributed in just such a manner as is found in the South Georgia survey if the water at different levels is travelling with different velocities. Such differences in velocity have been demonstrated in the area. Here, too, will be found suggestions tentatively relating the hypothesis to certain ecological features in different ocean areas, to the tropical daylight surface fauna and to a possible bearing upon the distribution of the reef-building corals.

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Contributions to a biography of John Ray (1627-1705).

By Mr. D. C. GUNAWARDENA.

THE following critical notes are abstracts from chapter 8 of the author's 'Studies in the Biological Works of John Ray, M.A., F.R.S., 1627-1705'—a dissertation, presented in 1933, for the degree of Master of Science in the University of London. For fuller details reference may be made to the typed copies of the dissertation in the Libraries of the University of London and The Linnean Society of London, respectively :—

1. '*Mr. Ray of the Number of Plants*'.—This essay was first published in the Philosophical Letters of Derham. There is *no date* assigned to it and it is printed at the end of the book. It occurs again in the Memorials of Ray with the remark : 'This paper appears to have been first published in the Philosophical Letters'. From three items of internal evidence it is clear that the essay was written after the publication in 1673 of Ray's *Travels* and before 1682, the date of the '*Methodus Nova*'. It is very likely that the essay is an abridged edition of the '*Discourses on the seeds of Plants and the Specific differences of Plants*', read before the Royal Society on 17 December 1674.

2. *Willughby and the second itinerary*, 26 July 1661.—Derham, Lankester, and others mention that Willughby accompanied Ray on this journey. More evidence is brought to confirm Gunther's statement* that Willughby did not accompany Ray on this journey.

3. *Scott : Select Remains and Life of Ray*, 1740. *Ray's Letters to Derham*.—Scott thus refers to the Ray-Derham correspondence in his dedicatory epistle to his book :—'The three letters from Mr. Ray to Dr. Derham are not in the collection just mentioned (Philosophical Letters published by Dr. Derham), I have, therefore, given them a place among the Remains'. But we find only two letters, and these possess different dates. Lankester, who edited Scott's *Select Remains &c.* of Ray, has omitted these three letters and also Ray's letter of advice to his two pupils. We find instead the essay, '*Of the Number of Plants*', taken from the Philosophical Letters of Derham.

4. *Lankester : Correspondence of Ray*, 1848.—Gunther has referred to the repetition of a letter on pp. 194 and 463, respectively. There is another repetition of a letter dated 11 February 1684. The full letter appears on pp. 138-41, and the main body of the same letter is printed as a separate letter on pp. 161 and 162.

* See '*Journal of Botany*', lxxii, 220 (1934).

5. *The Letters of Dr. Hotton of Leyden*.—Derham, in his preface to the Philosophical Letters, explains that the letters of Dr. Hotton were not published because 'the Doctor's relations strictly forbade the publication of any of them'. The truth is that the doctor himself was against their publication, as is shown by a letter to Dr. Hans Sloane, written by S. Dale on 20 August 1712 (Sloane MSS. 4043, f. 82).

6. *Gunther: Further Correspondence of John Ray—1928. The Winter of 1683 and Padua*.—Gunther writes (p. 86):—'The next paper by Ray was not printed in the Philosophical Transactions until some years after his death. Its title implies that Ray revisited Italy in the winter of 1683 and attended the lectures of Professor Domenico di Marchetti at Padua—a fact that has not been hitherto recorded by his biographers, who assume that he resided at Black Notley from 1679 to the end of his life'. The reviewers of Gunther's book are silent on this matter. But Ray did not revisit Italy. These anatomical observations at Padua were made by Ray in the course of his travels in 1663. Ray himself refers to Marchetti in the Travels. Besides, P. Skippon who accompanied Ray makes full and detailed reference to Marchetti in his own account of these travels. This formed Chapter XII in vol. vi of 'A Collection of Voyages and Travels', London, 1732, and bore the title, 'A Journey through part of the Low-Countries, Germany, Italy, and France, by Philip Skippon in company with the celebrated Mr. Ray, Mr. Lister, Mr. Willughby, and Mr. Henry Massingberd'. These observations were reported to Dr. Hans Sloane by Samuel Dale (Gunther: op. cit. p. 86). The Sloane MSS. (3323, f. 52 and 4025, f. 94) of these observations contain no date and we do not possess Sloane's note to the printer. It is highly probable, therefore, in the light of the above evidence, that Sloane, in noting the exact date, 1663, may have written the second 6 with a rather long loop, which the printer would mistake for an 8. Hence the error of 1683 for 1663.

7. *Wilkins: 'Real Character', and Ray's 'Tables of Plants'*. In the index to Gunther's Further Correspondence of Ray, we find two references under Wilkins: (a) Real Character, (b) Universal Character. Both refer to one book. A 'Universal Character' was suggested to Wilkins by Dr. Seth Ward, as we find in the epistle to the reader, and till 1667 references were made to a Universal Character, but the book which was published in 1628 was called 'An essay towards a real character and a Philosophical Language'. Wilkins acknowledges his indebtedness to those who helped him in drawing up his different Tables. Ray was responsible for the Tables of Plants. But F. J. Cole in his 'The History of Protozoology'

(1926) refers to the Tables as if they were the work of Dr. Wilkins. This is clearly an oversight. The Tables were drawn up by Ray for Dr. Wilkins.

8. The chapter concludes with biographical notices of Ray's chief correspondents ; a Ray bibliography and a general bibliography.

The following papers were read in title :—

‘The Arctic Plankton collected by the *Nautilus* Expedition, 1931. Parts 1–3.’ By A. C. HARDY, G. P. FARRAN, W. GARSTANG and E. GEORGESON.

‘The Reefs of the western Indian Ocean.—I. Chagos Archipelago ; II. The Mascarene region.’ By J. STANLEY GARDINER, M.A., F.R.S.

‘The petrography and significance of a rock dredged from a depth of 744 fathoms, near to Providence Isle, Indian Ocean.’ By JOHN D. H. WISEMAN, M.A., Ph.D. (Communicated by Prof. J. STANLEY GARDINER, M.A., F.R.S., F.L.S.)

‘Revised list of Reptiles (excluding Chelonians) and Amphibians collected in the Seychelles.’ By H. W. PARKER, M.A.

‘Concluding remarks on the distribution of the Land and Marine Fauna, with a list of the water temperature observations.’ By J. STANLEY GARDINER, M.A., F.R.S.

6 FEBRUARY 1936

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 30 January 1936, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The PRESIDENT drew attention to the donation from Mr. FRANCIS DRUCE, Treas.L.S., of a copy of ‘The Herbal of Pseudo-Apuleius from the ninth-century manuscript in the abbey of Monte Cassino [Codex Casinensis 97] together

with the first printed edition of Joh. Phil. de Lignamine [Editio princeps Romæ 1481] both in facsimile, described and annotated by F. W. T. Hunger, Sc.D., . . .', Leyden, 1935. A special vote of thanks was accorded to Mr. Druce for this donation.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted :—Mary Agard Pocock.

Certificates of recommendation of the following candidates for Fellowship were read :—For the first time, in favour of Ben Wells, Ivan Mackenzie Lamb and Noel Yvri Sandwith.

The President reported the death of Professor Friedrich Zschokke, Foreign Member of the Society,

The marine ecology of the South African coasts, with special reference to the habits of limpets. By Prof. T. A. STEPHENSON (Visitor).

PROF. T. A. STEPHENSON gave an account of ecological work which has been carried out during the past five years from the Department of Zoology, University of Cape Town. The work has been directed by Prof. Stephenson, and has been carried out by him with the assistance of the following workers :—N. A. H. Bokenham, K. M. F. Bright, W. G. H. Coaton, C. A. du Toit, E. J. Eyre, A. Sand, A. Stephenson, E. von Holdt, and M. Wood. The work is as yet incomplete, and the present account is to be regarded as an interim report. The thanks of the workers mentioned were offered to the various systematists who have rendered the investigation possible by the determination of material. The study has been restricted to the area between tidemarks. The following is a summary of Prof. Stephenson's account.

The incidence of the warm and cold currents on the South African coast provides the problem under consideration. The Indian Ocean coast is bathed by the warm southward-flowing Moçambique current, known farther south as the Agulhas current. The west coast, from the latitude of the Cape Peninsula northward, is bathed by cold water (Antarctic Intermediate Water); this cold inshore water is due to upwelling, the water farther off shore being subtropical. In the neighbourhood of the Cape Peninsula the cold antarctic water and the warmer water of the Agulhas current meet, with the result that this narrow Peninsula lies between colder and warmer water masses, the difference of temperature between which may be as much as 8° C. on the same day.

This difference is a summer phenomenon, disappearing in mid-winter. Since there is perhaps nowhere in the world where water-masses of such different temperature are separated by so little land, the effect of this state of affairs on the fauna and flora between tidemarks is naturally of interest.

In order to study the state of affairs in the Cape Peninsula itself, it has been necessary to go farther afield in the first place, and to obtain a preliminary idea of the marine ecology of South Africa in general. This is being done by means of a series of surveys extending from Durban in the east to Port Nolloth in the west—places at almost the same latitude, but at which the sea-temperature is very different. The plan includes eight of these surveys, five of which are already completed. This preliminary study is being followed up by a much more detailed investigation, in and near the Peninsula, of the occurrence of a selected series of plant and animal species which appear, from the general surveys, to be specially sensitive to the influence of temperature. This series includes not only unrelated species, but certain groups of species which appear to promise interesting results; in particular the Molluscan family Patellidae. Later on it is hoped to proceed to an experimental aspect of the subject, with the object of explaining the observed distribution of some of the more sensitive organisms in terms of their reaction to temperature. Other items of work on similar lines are in progress.

The state of affairs so far revealed on the South African coast is as follows. At Durban, which is well outside the tropics, we have the picture of a region without coral reefs, but with a rocky coast whose pools are inhabited by a limited number of species of reef-corals. Accompanying these corals are numerous reef-haunting organisms of other kinds, both algae and animals. As one proceeds southward on the east coast, the tropical elements in fauna and flora diminish in number and frequency, until at Still Bay, although some of them are still present, they have ceased to be conspicuous, and a warm temperate fauna and flora are found. In False Bay the biota resembles that of Still Bay, but has fewer tropical and more cold-water components. Down the whole east coast as far as Cape Point, however (if we except certain particular places such as Hermanus), there is a notable lack of large algae. The algae on the whole are encrusting or moss-like, or form turfs or small to medium-sized tufts, and as a rule nothing larger than *Sargassum* is to be found. Along the west coast, from the Cape of Good Hope northward, a marked change is encountered. Here a strongly developed Laminarian zone is present, and includes the three Giant

Laminarians *Ecklonia buccinalis*, *Laminaria pallida*, and *Macrocystis pirifera*. Apart from these three, a considerable number of other relatively large algae are abundant. On the west coast the fauna is in part different from that of the east coast, but the difference is less conspicuous than in the case of the algae. Both algae and animals change to some extent as one proceeds northward from Cape Town to Port Nolloth, but there is much less change in this direction than there is from Cape Town to Durban.

In the course of these general surveys a considerable amount of information about the zonation of organisms between tidemarks has been collected.

Partly as an item in the general scheme outlined above, partly as a separate investigation, a detailed study of the South African Patellidae has been undertaken. In the Cape Peninsula there are eleven species of *Patella* (*P. argenvillei*, *P. barbara*, *P. cochlear*, *P. compressa*, *P. granatina*, *P. granularis*, *P. longicosta*, *P. miniata*, *P. oculus*, *P. patriarcha* and *P. pruinosa*), which show interesting differences in distribution, zonation and habit.

BREEDING.—All the eleven species breed in April–May; but the exact duration of the breeding-season has been determined only for *P. granularis*, which is fertile from about November to the subsequent August. Artificial fertilisations of all the species have yielded trochophores on the first and veligers on the second day after fertilisation. Normal veligers have also been obtained by fertilising the eggs of one species with the sperm of another, but it is not yet clear whether these veligers are genuine hybrids or are parthenogenetically produced.

ZONATION.—The eleven species exhibit a definite vertical zonation on the shore. *P. granularis* extends higher up than the others; *P. patriarcha*, *P. argenvillei* and *P. compressa* inhabit the lowest zones; and the others form a graded series between these extremes.

DISTRIBUTION.—Certain of the species are abundant in both the warmer and the colder water, but others appear definitely to prefer the one or the other. *P. longicosta* and *P. oculus*, abundant in the warmer water, begin to disappear in the colder; whereas *P. argenvillei* and *P. granatina*, extremely abundant in the colder area, diminish in the warmer. Probably only two of the species, *P. granularis* and *P. barbara*, are common the whole way round from Port Nolloth to Durban; and *P. granularis* at least shows a definite change in average size from the colder to the warmer water.

HABITS.—A special study of the habits of five of the eleven species has been undertaken. This study has been

carried out primarily, up to the present, by Miss M. Wood, and is being completed by Prof. Stephenson. The five species show interesting variations on a common theme, the details being as follows :—

Patella granularis.—This species resembles in its habits the European *P. vulgata*. Its zone extends higher up the shore than that of any of the other Cape species. Individuals living high up the shore, in the summer, typically form a definite coloured ‘scar’ on the rock, and this scar is used as a ‘home.’ The limpet makes excursions from its home during low water at night (to distances of as much as five feet), for feeding, and returns to its scar afterwards, remaining at home in the daytime. There is, however, considerable variation in behaviour, not only from one individual to another, but also from the upper to the lower part of the shore, from spring tides to neaps, and from winter to summer. Limpets removed from their scars and placed on the rock a short distance away sometimes return to their scars; and limpets making normal journeys from home sometimes return along the track along which they went out, sometimes by a different route. The species is apparently entirely herbivorous, and eats not only algae and lichens forming a thin encrustation on the rock, but also various larger species.

Patella oculus.—The zone of this species begins a little lower down the shore than that of *P. granularis*. The behaviour is very similar to that of *P. granularis*, but perhaps even more variable, and the animal appears to be rather more sluggish. The food is very similar to that of *P. granularis*.

Patella compressa.—This species differs from all the others in its habitat, since it does not attach itself as a rule to rock, but to the stem of the giant Laminarian *Ecklonia buccinalis*. In this situation, however, it follows the usual homing procedure, and commonly makes a scar on the stem of the *Ecklonia*, from which it makes feeding excursions. In this case the course of the excursions can often be followed by rows of tooth-marks which the radula makes as it rasps the surface of the alga. The food of the limpet includes the cortical tissue of the *Ecklonia*, together with epiphytes growing upon the latter.

Patella longicosta.—The zone of this species begins lower down the shore than that of *P. oculus*. In this instance the limpet is variable in habitat and in its food-preference when small, but a high percentage of adults occupy a characteristic position. Each limpet forms its scar upon a patch of one particular encrusting alga, *Lepadoderma africanum*, and makes short feeding-excursions, usually of a few inches only,

on its own patch of this alga. Apparently in such cases the *Lepadoderma* is the limpets' staple food, and forms a kind of 'garden' round the animals' scar.

Patella cochlear.—The zone of this species starts even lower on the shore than that of *P. longicosta*, and presents remarkable features. The distribution of the limpet is approximately co-extensive with that of *Lithothamnion* and the limpets are often spaced out rather evenly upon rock encrusted with this alga; their density is commonly of the order of 250 individuals to the square yard. These individuals are not all adults, but small specimens very frequently settle on the backs of larger ones. *P. cochlear* moves considerable distances when young, but the adults appear, as a rule, to be very sluggish, and to move most commonly within an area extending only up to about an inch from the edge of their shells. If organisms such as tube-building polychaets settle on the rock between the limpets, these form ridges between the areas in which the limpets habitually browse; and the browsing-field of each limpet then comes to lie in a crater-like depression. A typical adult limpet is surrounded by a neat fringe of fine red alga, of flattened growth-form like the grass in a lawn, and growing upon the surrounding *Lithothamnion*. This fringe forms a narrow 'garden' round the limpet, upon which it browses, but does not extend far from the edge of the animal's shell, and does not clothe the rock beyond the limpet's normal browsing-area. Although very many individuals of the species possess this garden, others lack it; and although the garden is most often formed of small fronds of *Gelidium pristoides*, its constitution varies considerably from one garden to another. The questions naturally arise, why are the gardens limited to the immediate vicinity of the limpets? and why does persistent browsing not appear to destroy them? Experiments have been carried out with a view to solving these difficulties, and part of the answer to the questions has been discovered; but further work remains to be done. There is a possibility that the gardens are perpetually renewed from spores taken in by the limpet when feeding, and passed out in its faeces; and certain ways in which gardens can be formed in the first instance have been directly observed.

The whole of the work outlined in this account is incomplete, and though the mass of data already to hand is considerable, much remains to be discovered. It is hoped that the evidence upon which the conclusions here stated are based will be ready for publication during the next few years.

Prof. E. W. MACBRIDE congratulated Prof. Stephenson on his paper, which he described as a good example of the best kind of zoological research.

He had only two questions to put : (1) he should like to know whether Prof. Stephenson had examined the larvae of the different species which he described and, if so, how far did the larvae of the different species resemble one another ?

(2) Did he know that Prof. Orton had attempted to show that different shapes of our Common Limpet, *Patella vulgata*, were confined to different zones of the beach ?

In reply to Prof. MacBride, Prof. STEPHENSON said that the Cape limpets had been reared, up to the present, only as far as the veliger stage ; that superficially the larvae of the several species appeared to be very much alike, but that a detailed examination had not been made. In reply to Prof. MacBride's second question, he stated that he was familiar with Orton's work on zonation in *Patella vulgata*, but that in commenting on the question of zonation in limpets he had intended simply to make the point that where eleven species were present the zonation presented a more distinct and complex picture than where only one species was involved. In reply to another question from Mr. Burkill it was stated that the alga so commonly forming the gardens of *P. cochlear* (*Gelidium pristoides*) is often found on the shells of limpets ; but these shells are overgrown so extensively with algae of various kinds, that *Gelidium* forms only one among many.

Mr. A. D. COTTON, Mr. I. H. BURKILL and the PRESIDENT spoke on the paper.

Botanical tour at the Cape. By Mr. S. GARSIDE.

Mr. S. GARSIDE gave an account of a botanical tour from Capetown to Clanwilliam, including a description of the country around Mamre, Saldanha Bay, Piquetberg and Grey's Pass.

Lantern-slides were exhibited illustrating some of the plants growing in the sand veld near Mamre ; *Antholyza ringens* L., *Leucospermum parile* Phillips, *L. hypophyllum* R. Br. and *L. tomentosum* R. Br., and the suggestion was made that the last plant might be a hybrid.

Several species of *Teloschistes* growing on bushes of *Putterlickia pyracantha* Loes. were observed at Saldanha Bay ; and at Pools (Piquetberg) the aquatic flora was examined, including the floating *Oxalis disticha* Jacq., which ejects the embryo from the seed by eversion of the turgid testa.

Protea glabra Thunb. from Clanwilliam was described, and photographs showing stages in pollen-presentation were exhibited.

At Nardouws Berg, a new species of *Haemanthus* producing a single, vertical leaf with centric arrangement of the palisade cells; a new species of *Lachenalia* with water-storage peduncle; and the rare *Leucospermum praemorsum* Buek were seen and collected.

Views of the passes through the 'mountain range of Africa' (van Riebeeck's term), including Tulbagh Kloof and Bain's Kloof were exhibited, and in conclusion a brief account was given of the vegetation at Cape Agulhas.

Miss E. L. STEPHENS said how pleased she was to be able to remain in England to listen to the papers that had been given that evening on South African natural history. Mr. Garside had shown views of scenery which must have appealed to all present. His account of the botanical treasures referred to flowering plants and lichens, but all other botanical groups which occurred in the areas he described provided abundant material for specialists, and the botanists in South Africa would welcome most warmly any workers from overseas who were prepared to tackle any of the problems.

Dr. A. B. RENDLE expressed his appreciation of Mr. Garside's very instructive and entertaining address and congratulated him on the opportunity of seeing in nature such remarkable plants as the *Lachenalia* with the water-storing peduncle and the striking monophyllous *Haemanthus*. He asked whether flowering specimens of the latter had been seen. He also commented on the success of the Australian *Acacia saligna* when planted in the dry flat bush-country, and recalled the rapid transformation he had seen to the north of Table Mountain, where a large area had been rendered habitable though at the cost of increasing destruction of the original vegetation.

Mr. J. RAMSBOTTOM agreed with the previous speakers about the excellence of Mr. Garside's slides. Paymaster Captain T. M. Salter, who had arranged the tour described, was an excellent collector, and anyone wishing to see his series of *Oxalis* could do so in the Botanical Department of the British Museum.

Professor F. E. WEISS, in expressing his appreciation of the very interesting account Mr. Garside had given of his expedition, enquired whether the mountain chain which Mr. Garside had referred to as 'the mountain range of Africa' formed the boundary between the regions of summer and winter rainfall.

Professor HALE CARPENTER said that he was particularly interested in Mr. Garside's remarks upon the red inflorescence of *Antholyza*, which was especially adapted for fertilization

by birds. He had often noted in East Africa that the red flowers of a certain very abundant plant, borne in rings round an upright stem, were extremely attractive to Sun-birds. This indicates that red is a colour particularly noticed by birds, and thus helps us to understand why bright red or orange are so commonly associated with obnoxious characters in insects, as in wasps or 'Lady-birds'. Blue and green are far less commonly so associated, and there is some evidence that blue is the colour to which the eye of birds is least sensitive.

In reply to Prof. Weiss, Mr. GARSIDE said that the 'mountain range of Africa' was not the watershed separating the areas of summer and winter rainfall.

20 FEBRUARY 1936

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 6 February 1936, having been circulated, were taken as read and confirmed.

The PRESIDENT exhibited the vellum sheet with the signature of HIS MAJESTY THE KING OF THE BELGIANS as an Honorary Member of the Society, which had just been received.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted:—John Walker Walton.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time, in favour of Ben Wells, Ivan Mackenzie Lamb and Noel Yvri Sandwith; for the first time, in favour of Thomas Edward Hughes.

On the distribution of the Collembola of the genus *Ceratrimeria* Börner, with special reference to the Tasmanian and New Zealand species described by Sir John Lubbock in 1899. By H. WOMERSLEY, A.L.S.

Sir EDWARD POULTON, on behalf of Mr. Womersley, said that the paper dealt with three species of Collembola described by Lubbock in the Journ. Linn. Soc., Zool. Two of these, from Tasmania, have only recently been rediscovered, while the third, from New Zealand, has not until now been adequately re-examined. The three species form a separate geographical group belonging to the genus *Ceratrimeria*, here shown, following up a suggestion by Dr. J. R. Denis, to include also three other very definite groups corresponding to the Gondwana regions of America, Africa and Indo-Australia.

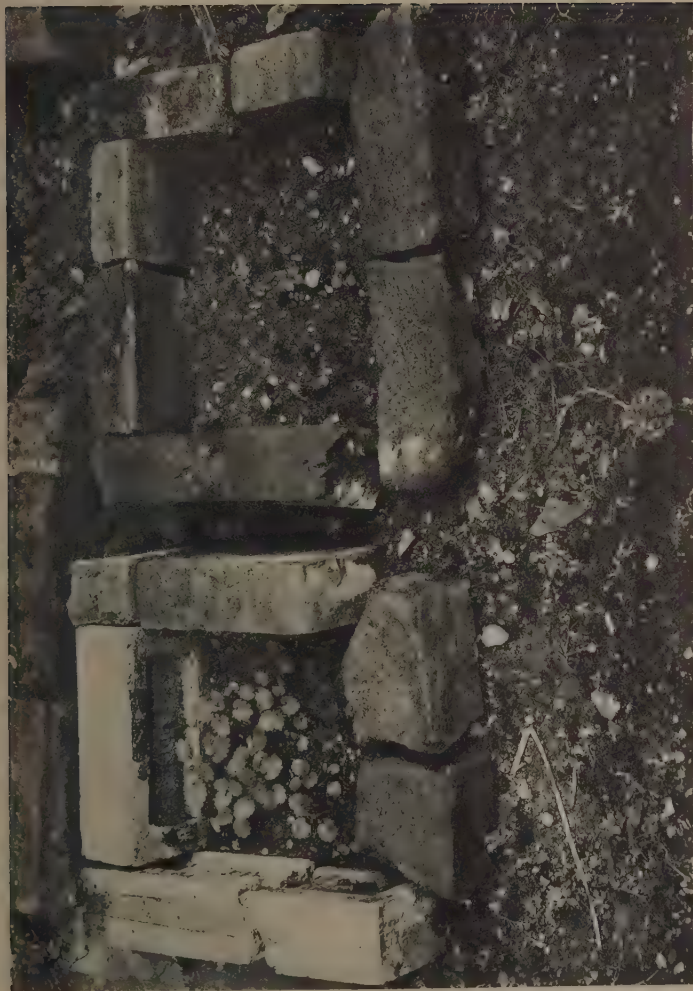
Notes on the fauna of San Cristobal Island, Solomon Islands.

By Mr. R. J. A. W. LEVER, B.Sc.

THE absence from San Cristobal of certain animals which occur in the islands to the west was noticed by Woodford in 1886, who showed (1) that the hornbill or 'bina' (*Rhyticeros plicatus mendanae* Hart.) and the white cockatoo (*Cacatua ducorpsii* Pucheran) were absent from this island. Similarly he stated the same about the bird-winged butterflies (*Ornithoptera*, or *Troides*, *priamus urvillianus* Guér. and *O. victoriae reginae* Salv.) among the insects. However, in May 1935, a female specimen of *Ornithoptera victoriae* was taken at Kira Kira, which is the first known record east of Guadalcanal; this, the first specimen from San Cristobal, is nearest the typical form from Guadalcanal, but approaches the race *reginae* in the markings of its hind wings.

In the anonymously written 'Handbook of the British Solomon Islands' (2) it is mentioned that the local 'opossum' (*Phalanger orientalis breviceps* Thomas) may be absent from San Cristobal, but two females were also obtained by the writer in the same locality and at the same time as the butterfly. This must be taken to be the most eastern point of its range, as it is not known to occur in the Santa Cruz Islands.

Although the two birds mentioned before have failed to cross the 30 to 35 miles of open sea separating San Cristobal from Guadalcanal to the west and Malaita to the north-west, yet the first-named island has certain birds (fantails and flower-peckers) which appear to be peculiar to it. There is also a tortoise-beetle (*Metriona cristobalensis* Spaeth) which has so far only been taken on San Cristobal and Santa Ana, though it may be expected to occur on the other small islands off the northern coast. Good examples of inter-insular distribution among snails from brackish water are given by Guppy (3), who found a species of *Neritina* in a bed of loam in a river on San Cristobal (recently identified by the writer



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EXPERIMENTAL GROWTH OF THE DEAD-NETTLE.

as the Pui pui) where living forms have not been found, though they live in rivers on Guadalcanal and the Shortland Islands, which are distant 100 and 400 miles respectively. In the same deposit of loam, two species of *Melania* were found, although they now appear to be extinct in the Solomons. The small island of Santa Ana to the east has two peculiar species and Ugi to the north no less than five, all distinct from the Santa Ana and San Cristobal forms.

While it is premature to hazard much about the sequence of geological changes in the Solomons it is possible that the absence of certain faunal elements in San Cristobal, but accompanied by species-formation, may indicate that this island was the first to be separated from the former land-mass when this was broken up into an archipelago during what is believed to have been Cretaceous times. The resulting separation would allow of differentiation due to isolation from the land-mass to the west.

- (1) 'A Naturalist Among the Head-Hunters', C. M. Woodford, 1890.
- (2) 'Handbook of the British Solomon Islands Protectorate', 1923. Suva, Fiji. (Reviewed in 'Bulletin of the Imperial Institute', vol. xxii, no. 3, 1924.)
- (3) 'The Solomon Islands; Their Geology, General Features, and Suitability for Colonization', H. B. Guppy, 1887.

Dr. HUGH SCOTT remarked that some time ago he had examined the Nycteribiid bat-parasites collected by Mr. Lever. They were not obtained actually in San Cristobal, but in other islands of the Solomon archipelago, namely, Ysabel I. and the much smaller Russell I., both to the north-west. Their bearing on the present paper was that they furnished an indication of the possible existence of local races, even among Nycteribiidae, the species of which are usually very widely distributed, and often show no trace of segregation into races. No Nycteribiidae had been recorded from the Solomon Islands as far as he knew. The three species collected there by Mr. Lever had all been discovered originally in New Britain (Neu-Pommern), on the main island or adjacent islets, that is, nearly 200 miles west of the most north-westerly of the Solomons, and about 600 miles north-west of Ysabel and Russell. In two at least of the species the specimens from the Solomons differed in small details from those taken in New Britain.

Evidence that the Growth of the Dead-nettle, *Lamium album* L., is stimulated by the presence of the Stinging-nettle, *Urtica dioica* L. By Sir EDWARD B. POULTON, F.R.S.

[PLATE 1]

FOR many years I have taken every opportunity of observing the association between the White Dead-nettle and the Stinging-nettle, and have come to the conclusion that it is

not to be completely explained by the fact that both plants are peculiarly favoured by abundance of nitrates in the soil—the interpretation which, my friend Prof. A. G. Tansley tells me, is the one usually accepted. Such a hypothesis does not explain the characteristic presence of the Dead-nettle in relatively smaller groups of plants ‘let in’, as it were, to the borders of Nettle-beds and, less frequently, entirely surrounded by Nettle. And in the relatively few instances in which I have found the Dead-nettle growing apart from the Nettle this has been in places where the latter was close at hand and had probably only recently disappeared from the site of the former, leaving some favourable influence in the earth.

A few observations made in Wensleydale, Yorkshire, September 1934, may be mentioned. At Carperby, where the Stinging-nettle was very plentiful on the broad grassy margins of the road, nearly every patch included the Dead-nettle, at that time (September 20) in flower, while with several the Red Dead-nettle, *Lamium purpureum* L., was closely associated. This latter plant also grew vigorously apart from the Nettle.

At Aysgarth (September 24) the White Dead-nettle was very abundant in patches growing with the Nettle and also separately, but always in spots where it appeared probable that the Nettle had been. The conditions at Bainbridge (September 25) were very similar, but the Dead-nettle was less abundant.

A little higher up Wensleydale, at Hawes, Hardraw, Gayle, and the roads and paths between these two and Hawes, there was a great abundance of Nettle, but I met with not a single example of the White Dead-nettle in several days, and only one plant of the Red Dead-nettle (September 21) near Hardraw. At last I observed (September 23) a fine colony of the White Dead-nettle, in groups between and in two adjacent beds of the Nettle by the road-side between Hawes and Appersett. Much of the Dead-nettle was in flower and the plants were vigorous but not tall—perhaps a young colony, recently established.

A more prolonged and careful search would, of course, provide far more extensive data in the parts of the Dale which I visited, but there can be no doubt that the first-mentioned localities were very favourable to the growth of the Dead-nettle, and that it was in these places associated with the Stinging-nettle; also that, a little higher up the Dale, where the conditions were far less favourable, the same association was found to exist.

I had been first convinced of the probable existence of this association by observations made in walks near Oxford and

in the University Parks, and had reached what appeared to be the probable hypothesis that the Dead-nettle has developed an adaptive response to the stimulus provided by some normal product of the Stinging-nettle. This response and the resulting close association in growth had, it was suggested, been added to the strong superficial likeness which Lubbock * had explained as the direct and simple operation of Natural Selection upon the foliage of the mimicking Dead-nettle. Just as the association in flight between certain mimetic insects and their models requires something more than the development of a likeness—some adaptive response to stimulus, without which the resemblance would lose much of its power to protect, so it seemed probable that the close association in growth between Dead-nettle and Stinging-nettle had developed †.

The hypothesis having suggested itself the supreme necessity was an experimental test, and I vainly tried to induce my botanical friends to undertake this. It was therefore left to me to travel outside my own province and make the attempt myself.

1933, July 2.—Seeds were collected from one plant of *Lamium album*, growing with Nettle outside the Forest Lodge, Bagley Wood, near Oxford. Forty seeds were shaken free on the same day and kept in a chip box in a dry room.

1933, September 21.—A large basket was nearly filled with earth from a nettle-bed in Norham Road, Oxford, and stored in a dry workshop.

1935, July 30.—Twenty of the above-mentioned seeds were sown in a compartment about 9 inches square in the garden of 56 Banbury Road, Oxford, and twenty in a rather larger compartment a few inches to the south of the first. About 350 c.c. of sifted dry earth from the nettle-bed (equal to a large tumblerful) were scattered over the seeds in the first compartment, nothing except the garden soil over those in the second.

1935, September 27.—With the kind help of Mr. A. C. Hoyle, B.Sc., and Mr. F. A. Clinkard, the photographer, of the

* 'Flowers, Fruits and Leaves', Nature Series, Lond. 1886.

† It cannot be doubted that the true Nettle is protected by its power of stinging; and, that being so, it is scarcely less clear that the Dead-nettle must be protected by its likeness to the other. Moreover, . . . every one must have observed that the two species are very commonly found growing together' (pp. 128, 129).

An excellent illustration (Fig. 29, p. 128) shows the resemblance between the two plants in the wild state.

† A remarkable example of association in both morning and the return evening flight, at Bukit Kutu, Selangor, F.M.S., was recorded by the late Mr. A. R. Sanderson (Proc. Ent. Soc. Lond. 1920, p. lxiii). The three species of Pierine butterflies (*Delias*), three of Geometrid moths (*Dysphania*) and one Chalcosiine moth (*Psaphis*), flying in the migratory stream, are illustrated in *Ibid.* 1921, pl. A, p. v.

Imperial Forestry Institute, Oxford University, the photographs reproduced, about one-sixth of the natural size, in the accompanying Plate, were taken. The smaller left compartment then contained fourteen plants of the Dead-nettle, two being small; the larger right compartment contained eleven plants, all small*. Some of these can only be clearly seen with the aid of a lens.

1935, November 15.—Some of the remaining dry earth from the nettle-bed was examined by Mr. C. G. T. Morison, M.A., Oxford University Reader in Soil Science, who has kindly written the following report:—‘The soil has approximately 50 parts per million of Nitric N., which is high, and I think myself that the stimulus is in all probability due to that and to the other similar effects known to be caused by soil which has been dug and kept dry for some time. I think that far more experiments would be required before the improvement in growth could be put down to any specific nettle effect.’ This, indeed, was my object in making this simple little experiment—to induce botanists to undertake these researches.

Professor F. E. WEISS expressed his interest in Sir Edward Poulton’s experiments, but thought the improved growth of the Dead-nettle might be due to the top dressing of soil, which was probably rich in nitrogenous matter, as the Stinging-nettle favoured a soil rich in nitrogen. A more crucial test would have been to grow both sets of Dead-nettle seedlings in the same soil, but to include growing rhizomes of the stinging nettle in one of them.

Some further studies in Endemism.

By Dr. J. C. WILLIS, F.R.S. [Abstract.]

AFTER 30 years’ study of distribution, and especially of endemism, the author has arrived at conclusions which are by no means in accord with current theories. His views were partially brought forward in ‘Age and Area’, but were rejected by all but a few, partly upon *à priori* argument, partly upon their failure to account for individual cases in which some one factor was especially operative. In the last two years the kind help of Mr. John Murray has enabled the author to return to research. Starting from the principles laid down in ‘Age and Area’, many deductions have been made, which have always proved to be correct when tested upon the facts, and which have given many interesting and often surprising results. One of these is described in this paper, which is simply an effort to indicate the author’s

* To-day, 22 February 1936, the plants in the left compartment have grown so much and are so entangled that it is difficult to count them, but I believe that there are twelve. In the other, five plants, still very small, can be seen.—E. B. P.

position to some extent whilst a book upon geographical distribution is in course of completion.

Starting from the views already published, (1) that endemics in general are young beginners as compared with the wide-ranging species of their own genera in the same region, (2) that one species may give rise to another without itself being necessarily killed out, and (3) that the size of a genus goes mainly with its age so long as no unusual catastrophe occurs, it is evident that, on the whole, the older and larger a genus is, in a given range, the greater number and *proportion* of endemic species should it contain. Testing this upon the floras of the far outlying islands it proved always to be the case, and it showed also in a number of continental floras. As the deduction was made from more than one premise, a good proof was thus provided for the truth of the premises.

In making the tests, the floras were of course divided into their constituent parts, and at once there showed the most remarkable and almost universal difference in proportion of endemism between the Dicotyledons and the Monocotyledons. This discovery was followed up, and the genera were arranged in parallel tables. These, especially in such floras as those of the Hawaiian and Galapagos Islands, New Zealand, Juan Fernandez, and the like, show the most striking and consistent differences (cf. Table XII), which with one exception so far seen (cf. Table XX) are always in the same direction, and which to the author are best explicable upon the supposition that on the whole the present Monocotyledons appeared, and became dispersed, later than the Dicotyledons. There is no evidence in this work for actual origin, but there is some that might point to possible polyphyly.

One finds in Sardinia a parallel to the tables given for the far outlying islands, so that it would appear that the Monocotyledons were probably late in Europe also. One may therefore go on to make the further prediction that the Canary Islands, which are very old as islands, and are on the edge of the Mediterranean region, should show the Monocotyledons in a position, as regards the degree of endemism, even lower than that which they occupy in Sardinia. This also proves to be the case, and to a very striking extent, for the Canaries have only 27 Monocotyledonous endemics against 418 Dicotyledons.

A study of the Sardinian flora shows that very nearly all the genera that have endemics belong also to the British flora. They are, in fact, those genera which were in Sardinia long enough to produce endemics there, and therefore also old enough to reach the British Isles before these were cut off from the Continent. But if this be so, then, as the flora of the European Mediterranean countries is composed of much the same genera in all, these same Sardinian genera

should also have endemics in other suitable places in south Europe. This also proves to be the case (cf. Table XXVII) in a very marked manner, for nearly all show endemics in Spain, in Italy, and in the Balkans, and many in such little places as the Balearics or Crete, or even in France, which is getting a little far north for much endemism. In fact, nearly all the genera of any importance in the British flora are represented by endemics in southern Europe, these endemics making up the great bulk of the endemic flora of that part of the world (cf. Table XXIX).

[The following Tables have been selected by the author as specially illustrative :—]

TABLE XII.—HAWAIIAN ISLANDS (Hillebrand).
Genera of more than five species.

DICOTYLEDONS.				MONOCOTYLEDONS.			
	End.	Wide.	% en- demism.		End.	Wide.	% en- demism.
Cyrtandra	29	0	100				
*Cyanea	28	0	100				
*Pelea	20	0	100				
*Schiedea	17	0	100				
*Stenogyne	17	0	100				
*Kadua	16	0	100				
Phyllostegia	16	0	100				
*Campylothea	12	0	100				
*Raillardia	12	0	100				
*Clermontia	11	0	100				
Lipochaeta	11	0	100				
Pittosporum	10	0	100				
Coprosma	9	0	100				
*Lobelia	9	0	100				
Sicyos	8	0	100				
Delissea	7	0	100				
*Tetramolopium	7	0	100				
Euphorbia	7	0	100				
*Dubautia	6	0	100				
Zanthoxylum	6	0	100				
Geranium	6	0	100				
*Rollandia	6	0	100				
(Av. 93%)							
Scaevola	7	1	87	Eragrostis	7	1	87
Wikstroemia	6	1	85				
Lysimachia	5	1	83				
Peperomia	15	4	79				
				(Av. 73%)			
Solanum	5	2	71	Panicum	10	4	71
Ipomoea	0	9	0	Cyperus	11	5	68
28 gen.	208	18	Av. 93	3 gen.	28	10	Av. 73

* Endemic genera.

TABLE XX.—SEYCHELLES (Summerhayes).
All genera that contain endemics.

DICOTYLEDONS.			MONOCOTYLEDONS.
Archichlamydeae.	Sympetalae Inf.	Sympetalae Sup.	
100%.	100%.	100%.	100%.
Aphloia 1	Psychotria .. 5	Mimusops... 3	Pandanus ... 4
Begonia 1	Crateri-	Colea 2	Curculigo ... 3
Bosquia ... 1	spermum 1	*Northea..... 2	Thoraco-
Campno-	Gardenia ... 1	Achyro-	stachyum. 2
sperma... 1	Gynura 1	spermum 1	Bulbo-
Cassipourea. 1	Ixora 1	Carissa 1	phyllum . 2
Erythroxy-	Tarenna..... 1	Coleus 1	Agrost-
lum 1	Timonius ... 1	Maba 1	phyllum . 1
Excoecaria.. 1		Rapanea ... 1	*Deckenia ... 1
Gastonia ... 1		Toxocarpus . 1	Garnotia ... 1
Geopanax ... 1			Hypolytrum. 1
Grisolia ... 1			*Lodoicea ... 1
*Indokingia . 1			Microstylis . 1
*Medusagyne 1			*Nephro-
Memecylon . 1			sperma ... 1
*Neowormia . 1			*Phoenico-
Nepenthes... 1			phorium . 1
Pittosporum. 1			*Protarum ... 1
*Riseleya..... 1			*Roscheria ... 1
Soulamea ... 1			Schoenus ... 1
*Vateriopsis . 1			*Seychellaria. 1
			Vanilla 1
			*Verschaff-
			eltia 1
Allophylus . 66%	Canthium ... 66%		
Impatiens... 66	Oldenlandia. 50	Justicia 50%	Angraecum . 50%
Loranthus... 50	Randia 50		Eulophia ... 50
	Vernonia ... 50		Platylepis ... 50
Eugenia..... 33			
Ficus 20			
Phyllanthus. 20			

* Endemic genera.

TABLE XXVII.—SARDINIAN GENERA WITH ENDEMOS,
showing other centres of Endemism.

		SPAIN.	ITALY.	BALKANS.	FRANCE.	CORSICA.	BALEARICS.	SICILY.	CRETE.
Achusa	Borag.	Sp.	...	Bkn.					
Armeria	Plumb.	Sp.	It.	Bkn.	Fr.		Bal.	Sic.	Cr.
Asperula	Rubi.	Sp.	It.	Bkn.	Fr.	...	Bal.	Sic.	Cr.
Astragalus	Legum.	Sp.	It.	Bkn.	Fr.	Cors.	Bal.		
Bellium.....	Comp.	...	It.	..	...	...	Bal.		

TABLE XXVII (cont.).

		SPAIN.	ITALY.	BALKANS.	FRANCE.	CORSICA.	BALEARICS.	SICILY.	CRETE.
Bupththalmum ...	do.	...	It.	...	Fr.	...	...	Sic.	
Carduus.....	do.	Sp.	It.	Bkn.	Fr.	...	...	Sic.	Cr.
Centaurea.....	do.	Sp.	It.	Bkn.	Fr.	...	Bal.	Sic.	Cr.
Cirsium.....	do.	Sp.	It.	Bkn.	Fr.	...	Bal.	Sic., It.	Cr.
Genista.....	Legum.	Sp.	It.	Bkn.	Fr.	...	Bal.	Sic.	
Helianthemum...	Cist.	Sp.	It.	Bkn.	...	...	...	...	Cr.
Helichrysum ...	Comp.	Sp.	It.	Bkn.	Fr.	Cors.	Bal.	Sic.	
Hypericum.....	Hyper.	Sp.	It.	Bkn.	...	Cors.	Bal.	...	Cr.
Iberis.....	Cruc.	Sp.	It.	Bkn.	...	...	...	...	
Lactuca.....	Comp.	Sp.	It.	Bkn.	Fr., Sp.	...	...	...	Cr.
Lavatera.....	Malv.	Sp.	It.	...	...	...	Bal.	...	
Linaria.....	Scroph.	Sp.	It.	Bkn.	Fr.	Cors.	Bal.	Sic.	
Linum.....	Lin.	Sp.	It.	Bkn.	...	...	...	...	Cr.
Medicago.....	Legum.	Sp.	It.	...	...	...	...	...	
Micromeria.....	Labi.	Sp.	...	Bkn.	Fr.	...	Bal.	...	Cr.
Nepeta.....	do.	Sp.	It.	Bkn.	...	...	...	...	Cr.
Oenanthe.....	Umbell.	Sp.	...	Bkn.	...	...	...	...	
Orobanch.....	Orob.	Sp.	It.	Bkn.	Fr.	Cors.	Bal.	Sic.	
Phagnalon.....	Comp.	...	...	Bkn.	...	...	...	...	Cr.
Phelipaea.....	Orob.	Sp.	...	...	...	...	...	...	
Ranunculus.....	Ranunc.	Sp.	It.	Bkn.	...	Cors.	Bal.	Sic.	Cr.
Rhamnus.....	Rham.	Sp.	It.	Bkn.	...	...	Bal.	...	
Sedum.....	Crass.	Sp.	It.	Bkn.	Fr.	Cors.	...	Sic.	Cr.
Senecio.....	Comp.	Sp.	It.	Bkn.	Fr.	...	Bal.	Sic.	Cr.
Statice.....	Plumb.	Sp.	It.	Bkn.	Fr.	...	...	Sic.	
Verbascum.....	Scroph.	Sp.	It.	Bkn.	...	...	Bal.	...	Cr.
Vicia.....	Legum.	Sp.	It.	Bkn.	Fr.	...	Bal.	Sic.	Cr.
Allium.....	Lili.	Sp.	It.	Bkn.	Fr.	...	Bal.	Sic.	Cr.
Asphodelus.....	do.	Sp.	...	Bkn.	...	...	...	...	
Festuca.....	Gramin.	Sp.	It.	Bkn.	Fr.	...	...	Sic.	
Poa.....	do.	Sp.	It.	Bkn.	...	Cors.	...	Sic.	
Trisetum.....	do.	Sp.	It.	Bkn.	...	Cors.	Bal.	...	

TABLE XXIX.—ENDEMISM IN SOUTH EUROPE.
LEGUMINOSAE. (Spain, Italy, Balkans.)

BRITISH GENERA.				NON-BRITISH GENERA (synonymy ignored).							
	s.	i.	B.		s.	i.	B.		s.	i.	B.
Anthyllis ...	10	1	1	Adenocarpus.....	6	1	1	Hedysarum ...	3	-	1
Astragalus ...	22	2	30	Alhagi.....	-	-	1	Hymenocarpus ..	-	-	-
Cytisus.....	6	4	10	Amorpha.....	-	-	-	Laburnum.....	-	-	-
Genista.....	38	8	11	Anagyris.....	-	-	-	Lens.....	-	-	-
Hippocrepis .	4	-	-	Apios.....	-	-	-	Lotononis.....	1	-	-
Lathyrus.....	2	3	4	Argyrobium.....	-	-	2	Orob.....	-	-	3
Lotus.....	6	-	1	Biserrula.....	-	-	-	Petteria.....	-	-	1
Medicago.....	2	6	-	Bonjeania.....	-	-	-	Phaca.....	-	-	-
Melilotus.....	3	-	-	Calycotome.....	-	1	-	Phaseolus.....	-	-	-
Onobrychis .	8	1	3	Caragana.....	-	-	-	Physanthyllis .	-	-	-
Ononis.....	34	1	1	Ceratonia.....	-	-	-	Pisum.....	-	-	-
Ornithopus .	3	-	-	Cercis.....	-	-	-	Psoralea.....	-	-	-
Oxytropis ...	1	-	2	Cicer.....	-	-	1	Pterospartum ..	4	-	-

TABLE XXIX (*cont.*).

BRITISH GENERA.				NON-BRITISH GENERA (synonymy ignored).							
	S.	I.	B.		S.	I.	B.		S.	I.	B.
Trifolium ...	11	5	23	Colutea	-	-	-	Retama	2	-	-
Trigonella ...	2	-	1	Cornicina	3	-	-	Sarothamnus ...	8	-	-
Ulex	17	-	-	Dorycnium	-	-	-	Scorpioides ...	-	-	-
Vicia	11	6	5	Dorycnopsis	-	-	-	Scorpiurus	-	-	-
				Ebenus	-	-	1	Securigera	-	-	-
Doubtfully British.				Erinacea	1	-	-	Sophora	-	-	-
Coronilla ...	1	-	1	Galega	-	-	-	Spartium	-	-	-
Lupinus	4	1	1	Glycyrrhiza	-	-	-	Tetragonolobus ..	-	-	-
				Gonocytisus	-	-	-	Vigna	-	-	-
				Hammatolobium ..	-	-	-				
British genera	17	with	309	endemic species.				18	per	genus.	
Doubtfully British ...	2	"	8	"	"	"	"	4	"	"	
Non-British	45	"	42	"	"	"	"	1	"	"	

S.=Spain.

I.=Italy.

B.=Balkans.

Dr. HUGH SCOTT remarked on the parallelism between certain of the conclusions to which Dr. Willis's investigation of floras tended, and those to which his own work on particular insect-faunas led. Ranging his comments under three heads, he noted that :

(i) In the case of the Seychelles archipelago Dr. Willis found that certain phenomena presented by the flora pointed in an exactly opposite direction to those exhibited by any other flora in the world. The same might be said of the Seychelles insects, in which there was a high percentage of endemism, but the endemics certainly did not look like ' young beginners as compared with the wide-ranging species of their own genera in the same region ' ; on the contrary, they appeared to be long-stabilized relicts of an ancient continental or sub-continental fauna, a great number of genera being represented by very few species apiece, and many of the genera themselves being endemic ; his views on this subject had not changed since the publication of his ' General conclusions regarding the insect fauna of the Seychelles ' *.

(ii) Dr. Willis had found striking contrasts between the flora of the Seychelles and that of the Hawaiian islands (as well as other insular floras). Dr. Scott had devoted certain sections of his ' General conclusions ' to a comparison of the insect-faunas of these two archipelagoes (his motive being to compare an ancient granitic with a purely volcanic archipelago) ; he also had arrived at striking contrasts, and he saw signs of the same kind of contrasts holding good between the two insect-faunas and between the two floras.

* Trans. Linn. Soc. London, ser. 2, Zool. xix, part 3, March 1933.

(iii) Bearing on Dr. Willis's contentions that 'endemics in general are young beginners' and that 'on the whole, the older and larger a genus is, in a given range, the greater number and proportion of endemic species should it contain', Dr. Scott thought that the work in which he was at present engaged, on the insect-faunas of the high mountains of eastern Africa, was leading him to conclusions fitting in with those views (that is, the opposite of his conclusions on the fauna of the Seychelles). He was specially concerned with certain genera and groups of Coleoptera which are represented by one or more endemic species on several (or all) of the mountain-ranges in the area under review. Many of these endemics belonged to very widely distributed genera. In some cases the endemic species might be relicts of an ancient fauna—according to a prevalent view, Palaearctic relicts—but many others appeared to have originated comparatively recently from ancestral forms in the surrounding parts of Africa at lower altitudes. Some of these views had been set forth in his paper on the Coleoptera associated with giant *Lobelias* and *Senecios*, and they were largely in agreement with opinions expressed by Dr. Uvarov about the Orthoptera obtained at high altitudes in Abyssinia*.

Dr. HAMSHAW THOMAS said that Dr. Willis had produced a wealth of interesting data which must be significant, but without careful and detailed consideration of the tables it seemed unwise, either to express agreement with the interpretation which had been given, or to attempt constructive criticism. It was clear that within certain affinities genera showed a greater tendency to exhibit endemism than was seen in other alliances. This might mean that the Symptetales mutated more readily than the Archichlamydeae and the Monocotyledons mutated less readily; it was not immediately apparent that such mutation was an indication of the relative age of the three groups. The only direct evidence as to the age of a genus was that derived from the study of fossil plants. It had been held that the records of the Upper Cretaceous and Tertiary floras were of little value owing to the unreliability attaching to the determination of the remains of fossil Angiosperms. Hooker had remarked upon the impossibility of identifying fossil leaves with any certainty, but recent advances in palaeobotany had greatly altered the position. We need no longer rely merely on the evidence of external form, the study of cuticular characters had provided many additional features of diagnostic importance. Again, the modern advances

* See Uvarov, Journ. Linn. Soc. London, xxxviii, pp. 591-614, 1934, and Scott, *op. cit.* xxxix, pp. 235-283, 1935.

in our knowledge of wood anatomy had assisted us in the identification of fossil wood, while the discoveries of reproductive structures gave our studies a firm basis. We have not only a knowledge of many fruits and seeds, such as have been described by Mrs. Clement Reid and Miss Chandler, but information is now coming in from the study of the pollen grains found in Tertiary rocks. When all this work is correlated we can no longer doubt the antiquity of certain living genera, and the knowledge must be applied in the analysis of the tables presented by Dr. Willis. The study of the fossil floras indicates clearly that some of our present endemics had once a much wider distribution; they are in fact relicts. These relicts include not only such well known examples as *Ginkgo*, *Sequoia* and *Malonia*, but also flowering plants like *Artocarpus*. Nevertheless, it seemed impossible to regard all endemics as relicts, though in places like the Eastern Alps of Central Europe one may have recent mutations and relicts growing side by side. These considerations indicated that the status of each endemic should be separately investigated, even though this would involve very considerable labour. The new work of which Dr. Willis had spoken should certainly stimulate interest and lead to further progress in a most important subject.

Mr. H. N. RIDLEY asked what meaning Dr. Willis attached to endemics. He pointed out that the term in its old sense meant any localized plant, but this included comparatively recent evolution and the relics of an ancient almost lost flora, now called epibiotics. He cited *Magnolia kobus*, now restricted to South Japan, which was formerly an abundant plant in Holland in the Pliocene, and *Cinnamomum lanceolatum* of the Bembridge beds (Eocene) of the Isle of Wight, which is identical with *C. pedunculatum* var. *angustifolium* now confined to a small area in China, surrounded as both of these plants were by others of the same genus. How was it possible to separate the true endemics from the epibiotics? He pointed out also that the Canary Islands were a detached portion of the African and Mediterranean coasts, and that a great part of their so-called endemic flora must be the relics of the African flora now submerged under desert sands, and some, e.g. the local Date Palm, were certainly epibiotics of the lost flora.

Mr. S. GARSIDE said that in considering the statistics Dr. Willis had put before the meeting we must distinguish carefully between the deductions to be made concerning the relative ages of the genera in the areas under consideration and those relating to the absolute ages of the groups. He also said that Dr. Willis had made several comparisons between the floras of Britain and south Europe, but with what

justification was not clear, because after the catastrophe of the Ice Age the relative rates of migration of the components of the British Flora must have had considerable influence upon its present constitution.

Dr. A. B. RENDLE remarked that Dr. Willis's elaborate tables called for careful thought and consideration. He expressed appreciation of the care and industry represented by their compilation.

The author replied briefly, the time available not allowing of a proper reply.

5 MARCH 1936

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 20 February 1936, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted :—James Harold Turner and John Evan Adlard.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Thomas Edward Hughes ; for the first time, in favour of Paulus Edward Pieris Deraniyagala, Neil Alison Mackintosh and Donald Vanstone.

The following candidates, whose names were read for the third time, were balloted for and elected Fellows :—Tiruvilandur Srinivasa Raghavan, M.A., Bernard William Harrison Coulson, Myfanwy Ellis, M.Sc., George Edward Trease, Ph.C., Thomas Ashton Lofthouse, Ben Wells, Ivan Mackenzie Lamb, B.Sc., Noel Yvri Sandwith, M.A.

The following papers were read in title :—

‘On Hippolytid prawns of the genus *Ligur*, Sarato.’
By ISABELLA GORDON, D.Sc., Ph.D. (See p. 102.)

‘The periodic swarming of *Anchistioides antiquensis* (Schmitt) (Crustacea Decapoda) at Bermuda.’ By J. F. G. WHEELER, D.Sc., and F. A. BROWN, jun., Ph.D.

‘On the feeding mechanism of the nauplius of *Balanus perforatus* Bruguière. By JOHN H. LOCHHEAD. (Communicated by Prof. J. STANLEY GARDINER, M.A., F.R.S., F.L.S.)

‘Descriptions and records of Nycteribiidae (Diptera, Pupipara), with a discussion of the genus *Basilina*.’ By HUGH SCOTT, Sc.D.

‘A contribution to our knowledge of the biology of certain Sawflies of the genus *Empria* Lep.’ By HERBERT W. MILES, Ph.D. (Communicated by Prof. H. GRAHAM CANNON, Sc.D., D.Sc., F.L.S.)

For this meeting a series of exhibits had been arranged, and after some of the exhibitors had made brief statements, the Meeting adjourned to the Library. The following exhibits were shown :—

Genetic control of aleurone and endosperm colour in Maize.

By Dr. F. G. BRIEGER (Visitor).

THE endosperm and its outermost layer, the aleurone, is formed after a process of fertilisation, just as is the embryo. The genetical study of endosperm and aleurone factors has several advantages. When studying plant characters one has to grow the plants from the seeds harvested in the previous year, while the segregation of endosperm characters can be seen at once at harvest. But the saving of time and labour is not the only advantage. There is one fundamental difference between the embryo and the endosperm. The embryo results from the union of one female and one male nucleus, the endosperm from the fusion of two female nuclei with one male. The triploid endosperm thus furnishes more material for the study of factor interaction than does the diploid plant. In the latter we have only one type of monoheterozygote. In the endosperm we can obtain two such types: the duplex heterozygote with two dominant alleles and one recessive allele, and the simplex heterozygote with one dominant and two recessive. The study of the interaction of multiple alleles has given results which can best be explained by Goldschmidt's theory of the physiological action of genes. There is, according to this theory, no fundamental difference between the so-called dominant and recessive genes. The difference is one of quantitative action. Every allele contributes a certain constant quantity of something, for instance of a sugar necessary for anthocyanin formation. The quantity

contributed by dominant genes is generally bigger than that contributed by recessive factors. If the total contributed by all genes of a given genotype exceeds a certain physiological limit we obtain what we generally call the dominant effect, if the total falls short of this limit we obtain the recessive effect. On this hypothesis the so-called 'dominant inhibitors' are to be explained as alleles which contribute extremely little. The quantity contributed by one or two dominant alleles and one or two quantities of this very weak allele are together not strong enough to exceed the physiological limit.

There can be no doubt that in other cases the difference between allelic genes will prove to be of a qualitative nature, as assumed by the older theory of dominance. The study of translocations and deficiencies has shown that there are cases where the old presence and absence theory of dominance gives a correct interpretation of the facts.

The rock-boring barnacle, *Lithotrya*, from the Great Barrier Reef. By Prof. H. GRAHAM CANNON.

PROFESSOR H. GRAHAM CANNON exhibited specimens of *Lithotrya* collected by the Great Barrier Reef Expedition showing (1) a form which agreed closely with the original description of *Anatifa truncata* Quoy & Gaimard, and (2) a specimen closely similar to that described by Charles Darwin as *Lithotrya truncata*. All the specimens in the collection have been classed as *Lithotrya valentiana* Gray.

The Butterflies of Abyssinia.

By Prof. G. D. HALE CARPENTER, M.B.E.

'ABYSSINIA', for the purposes of these notes, means not the area within the political boundary, but the area bounded by the contour of 1500 metres within that boundary.

This area contains about 400 species of butterflies, with a large number of named forms. The affinities are mainly *East African*, but in a surprisingly large number of cases they are *Western*. The typical West African fauna is that of the forest region, and butterflies support Wayland's theory that during the Pleistocene pluvial periods the western forests may have extended up the rivers at least as far as what is now known as South Sudan. But while a number of characteristically western species or forms have reached this area, most have not penetrated further. There are, however, in Abyssinia, 74 species or forms whose recorded distribution is typically western, or which find their nearest representatives in West Africa. Some of these, which frequent bush rather than forest, and others which occur in the interior of Northern Nigeria and the Cameroons and then again in Uganda, south

Sudan, and Abyssinia, suggest that there was formerly a belt of thicker bush stretching across from west to east through the Bahr-el-Ghazal.

Abyssinia is the only African part of the Ethiopian zoogeographical region into which species have penetrated from the Palaearctic zone. There are 6 of these, but they have not (with one peculiar exception) got out of Abyssinia again.

The common 'Small Copper' occurs as a local race, but other local races exist on the East African highlands, while a second species of the genus is found in South Africa: these facts suggest that the genus is not an invader but a relict of former days. Three links with Arabia suggest a possible way of entry for Palaearctic species into Abyssinia.

The presence of invaders in Abyssinia but nowhere else in Africa, and the absence from Abyssinia of species widespread in Africa and even abundant on the mountains of southern Sudan, suggest that the establishment of a surrounding arid belt, after the pluvial period, imprisoned the invaders and prevented others from entering from East Africa.

Trial proof of page of the 'Species Plantarum', ed. 1, showing that Linnaeus had thought of adopting a folio format for that work. By Mr. S. SAVAGE.

IN a guard book containing some miscellaneous items in Linnaeus's library I have noticed recently a trial proof of a page for the 'Species Plantarum', small folio in size (32 × 19 cm.). It appears in the list of contents as 'Specimen page of Hort. Cliff. in sm. fol.', in spite of the fact that Sir James Edward Smith had written a pencil note on it 'Trial sheet of Sp. Pl. ed. 1?' It is interesting, not only on account of showing that Linnaeus had contemplated publishing his *magnum opus* in folio, but because it helps to throw some light on the MS. which has hitherto been accepted as that of part of the first edition of the 'Species Plantarum'. In this trial proof there are recorded, with an appalling number of printer's errors, 14 species of *Croton*. The first edition of 'Species Plantarum' has only 13 species in that genus, because Linnaeus had transferred the first species of the trial proof, *Croton aromaticum*, to *Clusia Cascarilla*. He also transferred the specific name *aromaticum* to the species he had named in the trial proof *Croton fragrans*.

Under *Croton* in the so-called MS. of the first edition of 'Species Plantarum' are to be found only three species, the first *C. aromaticum*, unnumbered and with the specific epithet altered to *Cascarilla*, and the whole entry deleted, no. 10, which is no. 11 of the trial proof, and no. 13, which is

no. 14 of the trial proof. (Throughout this MS. the initial letters of generic names are written in the margins with the specific epithets; and they are so printed in the trial proof.) It would appear, therefore, that the trial proof was printed from 'copy' made by Linnaeus just before his final revision. Although the so-called MS. of the first edition of the 'Species Plantarum' bears traces of that final revision, it is obviously not the MS. that was sent to the printer. The MS., which is very imperfect, was originally in book form, and appears to have been liberally drawn upon by Linnaeus for his final MS., probably to save the burden of much rewriting. Moreover, the MS. nowhere bears any trace of having passed through the printer's hands. The 'Philosophia botanica' is the only Linnaean MS. known to me that is with certainty the 'copy' sent to the printer. It is in Loeffling's handwriting, with Linnaeus's corrections and additions. It has not only the sheet-signatures written in by the printer, but bears on its leaves the finger-marks of the compositor.

**Photographs of South African succulent Asclepiadaceae by
Dr. Herbert Lang.** By Dr. H. G. SCHWEICKERDT.

DR. SCHWEICKERDT had on view an extraordinary series of photographs made by Dr. Herbert Lang of some of the less-known members of the Stapelieae (succulent Asclepiadaceae). These photographs, partly taken *in situ*, and partly from cultivated plants, including several type and topotype plants, were remarkable for their clarity and detail. They were specially made to show the structure of the corona, a part of the flower which in this tribe of plants is of the utmost taxonomic importance.

A problematical fossil. By Mr. D. J. SCOURFIELD, I.S.O.

MR. SCOURFIELD exhibited a number of specimens and photographs of a problematical fossil from the Upper Silurian (Ludlow Beds) of Logan Water, Lesmahagow, Lanarkshire, together with a drawing showing a reconstruction of the organism so far as it can be made out from the material available.

John Sebastian Miller's 'Icones Novae' (1780).

By Dr. T. A. SPRAGUE.

This consists of one leaf of text and seven folio plates, including the earliest illustrations of *Strelitzia reginae*.

Only 5 copies appear to be known: at Kew, British Museum, Uppsala, Göttingen, and Vienna.

Preparation of Echinoderm Larvae. Examples of the use of dilute iron-haematoxylin as a general stain for small animals. By Dr. G. S. CARTER.

Abnormal seed-bearing leaves of Ginkgo.

By Dr. J. M. DALZIEL.

Two leaves of *Ginkgo biloba* Linn., each bearing a ripe seed on the margin. The specimens were received from Mr. A. H. Crook, late of Hong Kong, and were taken from a sacred tree beside which a temple was erected, about 60 miles from Tokyo. This tree is said to produce its seeds always in this position. Similar examples are figured in the 'Japanese Botanical Magazine', vol. v, p. 342, and vol. x, pl. 1.

Model of a sperm whale, *Physeter catodon*, with human figure made to same scale. By Mr. F. C. FRASER (Visitor).

A COLOURED plaster model of a Sperm Whale (*Physeter catodon*) made to the scale of an inch to a foot was exhibited. The model was constructed in the British Museum (Natural History) by Messrs. P. and S. Stammwitz from data and photographs supplied mainly by the 'Discovery' Committee.

Spolia Bermudiana. By Prof. WALTER GARSTANG.

IN his exhibition of *Spolia Bermudiana* Prof. Garstang displayed specimens of various pelagic Tunicata and a variety of delicate larval forms as examples of the wealth of pelagic life in Bermuda waters, and of the excellent condition in which they can be brought to workers in the Laboratory. Among the objects shown were the large Appendicularian *Megalcercus abyssorum*, tailed larvae, oozoids, phorozoids, and gonozoids of *Doliolina mülleri* and *Doliolum denticulatum*, large ciliated larvae of *Balanoglossus* (*Tornaria*) and the Holothurian *Stichopus* (*Auricularia*), and a curious post-larval Teleost (apparently a Gonostomatid), in which the intestine is produced into a trailing ventral appendage longer than the fish's whole body.

Some uncommon British Grasses*. By Mr. C. E. HUBBARD.

THE following grasses were among those exhibited:—

Bromus lepidus Holmb. f. *lasiolepis* Holmb., *Poa angustifolia* L. forma *albida*, *Lolium perenne* L. var. *longiglume* Grantz., *Elymus arenarius* L. × *Agropyron pungens* R. & S., *Nardurus maritimus* (L.) Janchen, *Apera interrupta* (L.) Beauv., *Pholurus incurvus* (L.) Schinz & Thellung.

* See p. 108.

Specimens showing the evolution of a paniculate inflorescence from axillary flowers in the Ericaceous genus *Pieris* and related genera. By Dr. J. HUTCHINSON.

EVOLUTION of the paniculate inflorescence from axillary flowers in the genus *Pieris* (*sensu* Benth. & Hook. f.) was indicated by a display of herbarium specimens. *P. nitida* Benth. & Hook. f., from Florida, with axillary flowers, is regarded as a primitive species. Various intermediate stages between this species and *P. formosa* D. Don, with a large panicle, were shown, amongst them being *P. villosa* Hook. f., from the Himalaya and Western China, with some of the leaves on the flowering shoot still well developed, the upper ones only being reduced to bracts. *P. ovalifolia* D. Don, from Japan, shows similar characters, and another particularly striking example was *P. macrocalyx* Anthony, a Chinese species, with partially reduced leaves.

A map showing the range of the genus in the south-eastern United States and eastern Asia was exhibited, indicating its distribution to be similar to that of such ancient families as Magnoliaceae, Winteraceae (*Illicium*), and Schizandraceae. Species with a paniculate inflorescence occur in both areas, its highest development in America being shown by *P. floribunda* Benth. & Hook. f., and in Asia by *P. Forrestii* Harrow ex W. W. Smith.

Photomicrographs of zoological material.

By Mr. DENYS A. KEMPSON (Visitor).

THE photomicrographs shown illustrate various methods of illumination required for widely differing subjects. Whereas transmitted light is used exclusively for the sections exhibited, photographs of isolated Placoid scales and teeth of Dogfish, *Obelia* colony, *Hydra fusca* and spicules of Holothurians were taken by means of dark ground illumination. Oblique incident lighting, almost parallel with the surface, was used for the dry specimens of the skins of Dogfish and Sole.

Living plants from the Royal Botanic Gardens, Kew.

By THE DIRECTOR, ROYAL BOTANIC GARDENS, KEW.

THE Director of the Royal Botanic Gardens, Kew, exhibited a cone of *Agathis vitiensis* Benth & Hook. f. ex Drake and also fruiting specimens of *Gnetum Gnemon* Linn. and a fruit of *Araujia sericofera* Brot. (Asclepiadaceae).

He also showed bulbs of *Nerine* with radial, longitudinal cuts across the base to induce the formation of the bulbils. The specimens showed several bulbils arising from the cut

edges of the bulb scales. Scales of various lilies were also exhibited showing young bulbils arising from the base. Large supplies of bulbs can be raised for commercial purposes by this means.

Sporelings of *Loxsoma Cunninghamii* were exhibited by Mr. FRANCIS BALLARD (Visitor) which had been grown at the Royal Botanic Gardens, Kew, from spores collected at Whangarei, New Zealand.

Loxsoma is a monotypic endemic genus of doubtful systematic position, and, so far as is known, is new to cultivation in this country. Combining the habit of a coriaceous *Davallia* such as *D. solida* with the sorus of a *Trichomanes*, it was placed by Hooker in the Hymenophyllaceae. Later on, a separate family, the Loxsomaceae, was suggested for it by Bommer, who regarded *Loxsoma* as a link between the Hymenophyllaceae and the Davalliaceae. Christensen, in his 'Index Filicum', Suppl. iii (1934), places the genus in a small group of 'genera incertae sedis' after the Hymenophyllaceae.

The spores germinated readily in sterilized peat and produced large numbers of sporelings. The prothallia appear to be strongly dichogamous (or unisexual) as in no case have antheridia and archegonia been observed on the same prothallus. Slides of prothallia in various stages were shown under microscopes.

Hybrid vigour in and growth of excised cotyledons of tomato.

By L. C. LUCKWILL (Visitor).

(i) *Hybrid vigour in tomato*.—Young plants (six weeks old) of two pure lines of tomato, viz., Blaby (P_1) and Chinaman (P_2), together with their F_1 hybrid (Blaby $\times$ Chinaman) were exhibited. The F_1 plants showed marked hybrid vigour. It has been demonstrated that this vigour is due, not to a greater relative growth rate, but to the fact that the hybrid embryos are larger than those of either parent strain. P_1 , P_2 , and F_1 embryos were exhibited in three stages of development, viz., 0, 1, and 2 days after removal from the seed. The F_2 embryos were markedly larger than those of either parent strain, and also showed more rapid development during the first four days. Drawings and growth curves were also exhibited.

(ii) *Development of roots on excised cotyledons of tomato*.—Specimens, drawings, and photographs were exhibited showing the development of roots from the wound callus on the cut end of excised cotyledons of tomato.

Botanical Press of A. L. de Jussieu.

By Mr. J. RAMSBOTTOM, O.B.E.

MR. RAMSBOTTOM exhibited a plant press which had belonged to A. L. de Jussieu. The press is made of mahogany and resembles a copying press. It takes only a small sheet of the size de Jussieu used for his herbarium, which is at Paris. The press was formerly in the possession of the late Dr. L.-L. B. de Beaumont, F.L.S.

The PRESIDENT moved a vote of thanks to the exhibitors.

On Hippolytid prawns of the genus *Ligur*, Sarato. By ISABELLA GORDON, D.Sc., Ph.D., Zoology Department, British Museum (Nat. Hist.).

(With 2 Text-figures)

(a) ON *LIGUR UVEAE* FROM FIJI. (Fig. 1.)

Some time ago I received from Mr. R. W. Paine two prawns from Fiji, which proved to belong to the somewhat rare genus *Ligur*. Only two species of the genus are known, namely, *L. edwardsii* Sarato, from deep Mediterranean waters, and *L. uveae* (Borradaile). The specimens from Fiji belong to the latter, a species with an apparently wide distribution in the Indo-Pacific region. *L. uveae* was first recorded from the Loyalty Islands and briefly described by Borradaile, who, however, omitted to mention that the propodi of the slender walking legs are multi-articulate. This omission was later made good by the same author when he recorded the species from Aldabra in the western Indian Ocean. But he did not mention that, in having the propodi of peraeopods 3-5 segmented, *Ligur uveae* is unique amongst the Caridea.

I have thought it necessary to extend the short description given by Borradaile and, as nothing was hitherto known of the habitat of this striking prawn, I add notes from a letter received from Mr. Paine. In contrast to *L. edwardsii* the Indo-Pacific species appears to be a shallow-water form.

My thanks are due to Mr. Paine for sending the specimens, together with data as to its habitat and occurrence in Fiji, to the British Museum, and also to Mr. J. H. Lochhead of the University Museum of Zoology, Cambridge, for sending me specimens of *L. uveae* from the Percy Sladen Trust Collection.

Ligur uveae (Borradaile).

Parhippolyte uveae Borradaile, 1900, in Willey's Zool. Results, pt. iv, p. 414; pl. xxxviii, figs. 11 a-g.

Ligur uveae Kemp, 1914, Rec. Ind. Mus. Calcutta, x, pt. ii, no. 4, p. 123; Borradaile, 1917, Trans. Linn. Soc. London, (2) Zool. vol. xvii, p. 401.

Material examined :—(a) 2 ♀ from Fiji, collected by R. W. Paine, Esq. (l.=106 and 86 mm. respectively). (b) 2 ♀ from

Uvea, Loyalty Is. (co-types, without peraeopods). (c) 1 ♀ from Aldabra* and 2 ♀ (one ovigerous) from the 'western Indian Ocean'* determined by Borradaile.

Description of female.—The *rostrum* is short, straight, and compressed, reaching approximately to the distal end of the penultimate segment of the antennular peduncle. It is continued backwards as a low keel terminating just beyond the middle of the carapace. The rostral formula is, as a rule, $\frac{2+1}{4-6}$; in one specimen from the western Indian Ocean there are two additional teeth on the proximal half of the upper border, so that the formula is $\frac{2+3}{5}$.

The *orbital border* is continued anteriorly as a low but distinct ridge on each side of the rostrum. The inferior orbital angle is a large obtuse lobe quite distinct from the 'postocular' † or antennal spine and, in some specimens, armed with a spinule (fig. 1 a). The branchiostegal spine projects slightly beyond the margin of the carapace and is continued backwards for a considerable distance as a prominent keel (fig. 1 a). Both supra-ocular and pterygostomial spines are absent.

The *stylocerite* is lateral to the basal segment of the antennular peduncle, is strongly compressed and carinate distally, terminating in a small spine (fig. 1 b). The penultimate and ultimate segments of the peduncle are short and subequal; the two flagella are long—probably almost, or quite as long as the body when complete,—and the upper has a fringe of short hairs for some distance along the proximal ventral margin.

The *antennal scale* is nearly twice as long as the antennular peduncle, broad near the base, and much narrowed distally; the length is approximately three times the greatest width. The antennal peduncle is very short and the flagellum at least twice as long as the body.

The *mouth-parts*, with the exception of the first maxilliped, have been figured by Borradaile (1900, pl. xxxviii, fig. 11 c-g).

The *first peraeopods* may be subequal as in the third specimen in Table I, or appreciably unequal as in the first and largest specimen measured. They extend to, or slightly beyond, the apex of the antennal scale. The dactylus has two dark horny claws at the apex, while the immovable finger has one large and one minute claw. The fingers are rather shorter than the palm.

* Borradaile, 1917, p. 401, simply states that the specimens are all from Aldabra.

† Borradaile (1900, p. 414) refers to 'antennal' and 'postocular' spines; from their relative positions in *L. edwardsii* they would appear to be the branchiostegal and antennal spines respectively.

The *second peraeopods* are long, slender, and rather unequal. The carpus, merus, and distal end of the ischium are subdivided. The total number of segments may be approximately equal

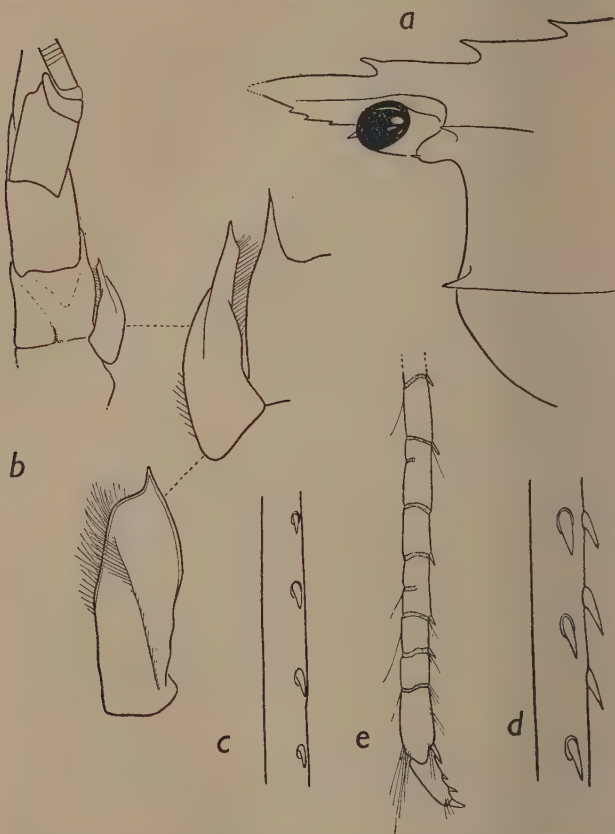


FIG. 1.—*Ligur uveae* (Borradaile), ♀. *a*, rostrum and antero-lateral margin of carapace, $\times 4$; *b*, antennular peduncle and stylocerite with enlarged figure of the latter in dorsal and lateral aspects, $\times 4$ & 9 ; *c*, merus of fourth peraeopod with one row of spines, $\times 9$; *d*, merus of third peraeopod with two rows of spines, $\times 9$; *e*, dactylus and distal end of propodus of fifth peraeopod, to show segmentation of the latter, $\times 9$.

in the right and left peraeopods as in the first specimen in Table I (50 and 52), or markedly unequal as in the second specimen (41 and 51). The distal segment of the carpus is subequal to the palm, which is slightly longer than the fingers.

The single terminal claw on the immovable finger interlocks with the two similar claws on the dactylus.

The *third peraeopod* is rather more robust than either of the following legs; the merus is long and armed with two rows of spines (one ventral, the other lateral), as represented in fig. 1 *d*. The carpus is rather longer than the propodus and the latter is subdivided into segments of rather unequal length (*cf.* fig. 1 *e*). The dactylus is of approximately the same length in all three walking legs, and has two small spines on the ventral margin in addition to the terminal claw (fig. 1 *e*).

The *fourth peraeopod*, in the largest specimen measured, is subequal to the third. It is clear from Table II, however, that the segments differ appreciably in length. The merus and carpus are shorter, the ischium and propodus longer, in the fourth than in the third peraeopod. The merus is more slender and, as a rule, has only one row of spines near the ventral margin (fig. 1 *c*). In one specimen there is a trace of the second series of spines (Table II, *l*=76 mm.).

The *fifth peraeopod* is very slender and considerably longer than either of the preceding, due largely to the elongation of the propodus, the distal five-sixths of which are subdivided into 21–25 segments. In two of the three specimens measured, the carpus is rather longer than in the fourth peraeopod (Table II).

The postero-lateral angles of the fifth and sixth *abdominal pleura* are acutely spinose.

The *telson* is much narrowed distally and almost as long as the endopod of the uropod. There are two pairs of spinules on the distal third of the dorsal surface in all the specimens examined (*cf.* Borradaile, 1900, p. 414). The apex is spinose and bears a long outer, and short inner, pair of terminal spines; dorso-lateral to the former is a pair of small sub-terminal spines.

The *pleopods* are long and narrow. The endopod of the first pair is about half the length of the exopod; that of the second pair is much longer—at least three-fourths of the exopod—and bears a conspicuous appendix interna.

The *branchial formula* agrees with that of *L. edwardsii* (Senna, 1903, Bull. soc. ent. Ital. xxxiv, p. 321, fig. 6).

Table I (p. 105) shows (in mm.) the length and breadth of the merus, carpus, and chela of the first peraeopods and the length of the ischium, merus, and carpus of the second peraeopods in three females of *L. ligur*. The numbers in brackets refer to the subdivisions present in the second peraeopods.

Table II (p. 105) shows the lengths of the main segments of the walking legs of the same three specimens. The numbers in () refer to the 1–2 rows of spines on the merus; those in [] to the subdivisions or segments of the propodus.

TABLE I.

Length of specimen.	Segment of peraeopod.	First peraeopod.		Second peraeopod.	
		Right.	Left.	Right.	Left.
106 mm. (Fiji).	Ischium ...	.....	.....	12.00 (3)	10.88 (3)
	Merus	11.60 × 2.08	10.88 × 1.52	11.52 (15)	10.64 (15)
	Carpus	9.60 × 1.76	8.48 × 1.44	22.80 (32)	21.60 (34)
	Chela	8.16 × 2.40	7.20 × 1.76	.....	.....
76 mm.	Ischium ...	.....	.....	10.40 (4)	10.64 (3)
	Merus	8.52 × 1.52	8.56 × 1.52	10.00 (12)	10.00 (16)
	Carpus	7.20 × 1.44	7.44 × 1.50	20.00 (25)	21.92 (32)
	Chela	6.72 × 1.60	6.80 × 1.68	.....	.....
76.5 mm. (ovig. ♀).	Ischium ...	.....	.....	(missing.)	11.20 (3)
	Merus	8.80 × 1.44	8.88 × 1.40	.....	11.28 (13)
	Carpus	7.60 × 1.36	7.60 × 1.28	.....	22.88 (26)
	Chela	6.48 × 1.60	6.48 × 1.60	.....	.....
<i>Ligur ed-wardsii</i> (l. = 88 mm.).	Ischium ...	.....	.....	10.56 (9)	11.28 (8)
	Merus	8.80 × 1.20	8.80 × 1.04	9.68 (28)	10.80 (30)
	Carpus	8.32 × 1.15	8.16 × 1.04	20.80 (44)	22.40 (44)
	Chela	6.63 × 1.28	6.48 × 1.20	.....	.....

TABLE II.

Length of specimen.	Segment of peraeopod.	Peraeopod 3.	Peraeopod 4.	Peraeopod 5.
106 mm. (Fiji).	Ischium	5.76	6.40	8.00
	Merus	24.80 $\left(\begin{smallmatrix} 12 \\ 11 \end{smallmatrix}\right)$	22.40 (12)	21.20 (10)
	Carpus	16.00	14.64	15.20
	Propodus	14.40 [14]	17.20 [19]	24.40 [23]
76 mm.	Ischium	4.80	5.44	6.40
	Merus	20.80 $\left(\begin{smallmatrix} 9 \\ 13 \end{smallmatrix}\right)$	19.04 $\left(\begin{smallmatrix} 3 \\ 12 \end{smallmatrix}\right)$	17.20 (10)
	Carpus	13.40	11.92	11.44
	Propodus .....	.....	15.20 [15]	19.36 [21]
76.5 mm. (ovig. ♀).	Ischium	4.72	5.60	6.16
	Merus	22.00 $\left(\begin{smallmatrix} 8 \\ 10 \end{smallmatrix}\right)$	19.52 (7)	18.00 (7)
	Carpus	13.56	12.16	12.72
	Propodus .....	.....	14.80 [21]	21.44 [25]
<i>Ligur ed-wardsii</i> (l. = 88 mm.).	Ischium	6.24	7.20	8.24
	Merus	16.00 (9)	17.12 (8)	16.80 (4)
	Carpus	9.06	9.20	10.56
	Propodus	17.44	20.00	24.80

Occurrence in Fiji.—I received the following data from Mr. Paine :—‘ This prawn occurs, as far as is known, in only three places in the group—on the islands Vatulele, Vanua Vatu and Vanau Levu. On the first mentioned island it is regarded by the natives as a “tevara” (devil) and the capture or eating of it is strictly “tabu.” A native legend says that whoever captures it will suffer shipwreck when he sails from the island. Being in nature of a rose-red colour the Fijians refer to it as “ura damudamu” (lit.=prawn red). The reluctance of the Fijians to touch it accounts for the fact that, although it has been known in the group for many years, very few specimens have been procured by collectors from the relatively inaccessible localities in which it is known to occur.

‘ It is found in land-locked pools of salt water shut off from the sea by coral rocks, through which, however, there is sufficiently rapid seepage to render the water level in the pools influenced by the rise and fall of tides.’—7. vii. 32.

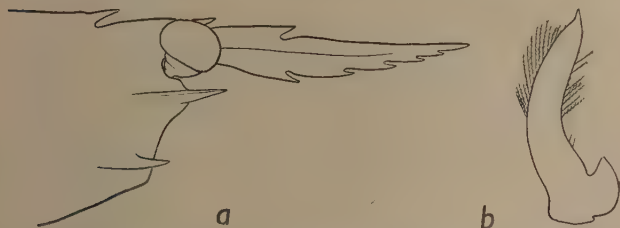


FIG. 2.—*Ligur edwardsii* Sarato, ♀. *a*, rostrum and antero-lateral margin of carapace, $\times 3$; *b*, left stylocerite in lateral aspect, $\times 9$.

(b) NOTE ON *LIGUR EDWARDSII* SARATO. (Fig. 2.)

In the British Museum Collection are two ovigerous females that were obtained from Nice (Gal frères) in 1890, as ‘*Palaemon edwardsii*’, by the late Canon Norman. One specimen is imperfect, the other is almost complete. There can be no doubt as to the identity of these specimens with *Ligur edwardsii* as described by Senna (1903, Bull. Soc. entom. Ital., ann. xxxiv, p. 321; pl. xvii, figs. 1–17). There is one error in the artist’s figure of the entire animal that gives a wrong impression (Senna, 1903, pl. xvii, fig. 1). The propodi of the walking legs are shown as tapering very much in the distal half, whereas they are of almost uniform diameter throughout and very slightly enlarged at the proximal and distal articulations.

Ligur edwardsii differs from *L. uveae* chiefly in the following respects :—(1) The rostrum is longer and more slender, and reaches almost to the apex of the antennal scale. (2) The

antennal spine is placed ventral to the rather rounded lower orbital angle and projects well beyond the anterior margin of the carapace* (cf. figs. 1 *a* & 2 *a*). (3) The branchio-stegal spine is continued backwards for a much shorter distance. (4) The stylocerite is much narrower, crescentic, and possesses a proximal dorsal lobule, but no carina (cf. figs. 2 *b* & 1 *b*). (5) The subdivisions of the carpus, merus, and distal end of the ischium of the second pereopod are more numerous (see Table I). (6) The propodus of each walking leg is simple (cf. fig. 1 *e*), and is always longer than the merus (see Table II).

Mr. C. E. HUBBARD has supplied the following comments on his exhibition (see p. 99) :—

Some uncommon British Grasses. By Mr. C. E. HUBBARD.

Notes on the specimens exhibited.

Bromus lepidus Holmb. forma **lasiolepis** Holmb. in Bot. Not. 1924, 326. *B. lepidus* forma *micromollis* Holmb. Skand. Fl. Hft. 2, 265 (1926). *B. gracilis* Krösche var. *micromollis* Krösche in Fedde, Repert. xix, 330 (1924).

SURREY: Richmond Park, in grassland near cornfield, 12-6-1930, *Herb. Kew.* 490.

In most species of *Bromus* of the section *Serrafalcus* there are forms with glabrous or hairy spikelets. Sometimes the hairy form is more common (e.g. *Bromus hordeaceus* L.), whilst in other cases the glabrous form is more often collected (e.g. *B. pratensis* Ehrh., *B. racemosus* L.). *B. lepidus* Holmb. usually has glabrous spikelets, but the form with hairy spikelets (f. *micromollis*) has been recorded from Germany and Sweden and has been found in a few localities in the British Isles. In Richmond Park it was growing in association with *B. lepidus* Holmb., *B. hordeaceus* L., and *B. hordeaceus* L. var. *glabratus* Druce.

Poa angustifolia L. forma **albida** C. E. Hubbard, forma nova, a typo spiculis albidis differt.

BERKSHIRE: Windsor, Frogmore, in Home Park, on chalk slope in shade of beech trees, May 1934, *Hubbard*.

A colony of this grass has been under observation for three years, and throughout that period whitish panicles have been produced. This character persists under cultivation. The

* In *L. uveae* the orbital lobe is entire. In *L. edwardsii*, however, there is a hint of the separation of the inferior orbital angle from the lower part of the lobe that bears the antennal spine. In *Periclimenes longicaudatus* Stimpson the antennal lobe is distinct from the orbital lobe.

normal green form is common in the same locality, where it grows under similar conditions. *Poa angustifolia* L. (*P. pratensis* L. var. *angustifolia* (L.) Sm.) may be distinguished from *P. pratensis* L. by its more caespitose habit, extremely narrow leaf-blades of the innovations, and smaller spikelets. In the Bot. Exch. Club Brit. Isles, Report for 1932, x, 456 (1933), an albino form of *Melica uniflora* Retz. is recorded from Matfield, Kent, by W. H. Pearsall. This is *Melica uniflora* f. *albida* Erick. ex Papp in Engl. Bot. Jahrb. lxx, 332 (1932).

***Lolium perenne* L. var. *longiglume* Grantzow**, Fl. Uckerm. 351 (1880); Rouy, Fl. France, xiv, 307 (1913).

HAMPSHIRE: East Meon, on roadside, July 1932, *Escombe*. Also in France and Germany.

This variety differs from typical *L. perenne* L. in having the lower glume as long as or longer than the remainder of the spikelet. In this character it resembles *L. temulentum* L., but may be separated from that species by the slender florets.

***Elymus arenarius* L. × *Agropyron pungens* R. & S.**

NORFOLK: between Heacham and Snettisham, on sand-dunes, 24-7-33, *Hubbard and Turrill* 9132 A.

Only one plant of this supposed hybrid was seen in flower. It had the habit of *Elymus arenarius*, but the leaf-blades were narrower, the culms and inflorescence more slender, the spikelets with fewer florets, the glumes narrower and tapering to a fine awned tip. The inflorescence is somewhat similar to that of *Elymus geniculatus* Curt., which suggests that the latter may be a hybrid between *Elymus arenarius* L. and a species of *Agropyron*.

***Nardurus maritimus* (L.) Janchen** in Mitteil. Naturwiss. Ver. Wien, v, 86 (1907). *N. tenuiflorus* var. *aristatus* Rouy, Fl. France, xiv, 300 (1913). *Festuca maritima* L. Sp. Pl. ed. 1, fol. cancell. 75 (1753); Syst. Nat. ed. 10, ii. 876 (1759); Loeffl. Iter. Hisp. 44 (1758); Journ. Bot. 1903, 314; Bot. Exch. Club Brit. Isles, Report for 1903, 8 (1904); l.c. Report for 1909, 421 (1910).

LINCOLNSHIRE: Carlby, just before the junction of the Cornbrash and Great Oolite Clay, in arid places, in great plenty, with *Festuca sciuroides*, Rev. *Adrian Woodruffe-Peacock*; 9-6-1903, Rev. *W. Wright Mason*.

KENT: Littlestone on-Sea, 1909, with native species, *Lady Davy*.

DEVON: Torbryan, south-west of Newton Abbot, on wall-top between road and pasture; three colonies were found on wall, one covering about 6 ft. of wall-top and comprising several dozen plants, the other two colonies on either side of

field-gate with about a dozen plants in each place ; the pasture had probably been recently under cultivation, whilst a barn and buildings are close at hand, 22 & 30-6-1935, *Rev. T. S. Stephenson*.

This slender grass has a wide distribution in the Mediterranean Region, with an extension to northern France and Belgium. A frequent habitat for it on the continent is on wall-tops or in other dry places. Its seed may have been introduced into England with that of some crop plant. On the other hand, its general distribution suggests that it is a native species which has been overlooked owing to its resemblance to some species of *Vulpia*.

According to Munro (*Proc. Linn. Soc.* vi, 45 ; 1862) and Jackson (*Index Linn. Herb.* 76 ; 1912) there is no specimen of *Festuca maritima* so named by Linnaeus in his herbarium. It should be noted, however, that Linnaeus, in his *Mant. Pl.* Alt. 325 (1771), refers *F. maritima* to *Triticum*, and the type-specimen is in the folder of that genus in the Linnaean Herbarium. The specimen agrees with Linnaeus's description and is written up 'maritima 6' by Linnaeus, the number 6 indicating that it was the sixth species of *Festuca* in the 'Species Plantarum'. On the back of the sheet is a copy of the diagnosis from that work and a queried reference to 'Gramen exile duriusculum maritimum Scheuch. Gr. 272'. Scheuchzer's description refers to *Catapodium loliaceum* Link ; this was realised by Linnaeus, who excluded the reference to Scheuchzer in his *Mant. Pl.* Alt. 325. Mention may be made here that the description of *Festuca maritima* does not occur in the first edition of the 'Species Plantarum' as originally printed ; *Festuca incrassata* L. appears instead on p. 75. This page was apparently cancelled and the description of *F. incrassata* replaced by that of *F. maritima*. Linnaeus may have received the specimen of *F. maritima* after the account of *Festuca* had been printed, as Loeffing collected it at Madrid in July 1752.

***Mibora minima* (L.) Desv.**

DORSET : near Wimborne, on heathland near a large garden, May 1928, *Mr. & Miss Haines* ; Ferndown, near Wimborne, in an uncultivated part of Stewart & Sons' Nursery, plentiful, but growing mainly in a wide gateway near the Ringwood Road, 23-4-1934, *H. J. Goddard*.

There are two well-known localities for this grass in the British Isles—in Anglesey and in the Channel Isles. Its occurrence in Dorset is without doubt due to its introduction with cultivated plants, possibly from the Channel Isles. The species is recorded from Stewart's Nurseries, in the Bot. Exch. Club Brit. Isles, Report for 1930, 377, where Ferndown is misspelt Ferndorne.

***Apera interrupta* (L.) Beauv.**

NORFOLK: West Newton, in old gravel pit, 9-7-1935, *Hubbard*.

This interesting species, of comparatively rare occurrence in England, is probably only native in a few scattered localities in East Anglia. The nearest previous known locality for it is Thetford, about 30 miles to the south of West Newton.

***Pholiurus incurvus* (L.) Schinz & Thell.** in Viertelj. Nat. Ges. Zurich, lxvi, 265 (1921). *Aegilops incurva* L. Sp. Pl. ed. 1, 1051 (1753). *Nardus articulata* L. l.c. 53, p.p. *Aegilops incurvata* L. l.c. ed. 2, 1490 (1763); p.p. *Lepturus incurvatus* Trin. Fund. Agrost. 123 (1820). *L. incurvus* (L.) Druce, List Brit. Pl. 85 (1908). *Pholiurus incurvatus* Hitchc. in U.S. Dept. Agric. Bull. no. 772, 106 (1920). *P. incurvus* subsp. *incurvus* (L.) A. Camus in Ann. Soc. Linn. Lyon, lxi, 89 (1922).

NORFOLK: Snettisham, on shingle, mixed with *Festuca rothboelliioides*, 21-6-1922, *Little*. (ex Watson Bot. Exch. Cl. Report for 1922-3, iii. 231; 1923); between Snettisham and Heacham, in muddy bank of creek, together with *Pholiurus filiformis*, 16-7-1935, *Hubbard*.

SUFFOLK: Dunwich, *Holmes* (ex Hind, Fl. Suffolk, 414; 1889).

ESSEX: Canvey Island, June 1848, *Ball*; Langenhoe, in immense quantity on chalk refuse, plants confined to spots covered by old chalk heaps unloaded there from barges; *Pholiurus filiformis* occurs in the same spot on unaltered soil, 25-9-1926, *Brown*.

SUSSEX: Seaford, sea beach (with *Pholiurus filiformis*), 14-8-1908, *Sherrin*; near Southwick (with *Pholiurus filiformis*), 4-7-1923, *Lady Davy*; between Seaford and Newhaven, on seaward side of road, 6-7-1924, *Sheldon* (ex Watson Bot. Exch. Cl. Report for 1924-25, iii. 320; 1925); west of Newhaven, chalk undercliff, 5-7-1931, *Lousley*.

HAMPSHIRE: near St. Catherine's Point, on banks near sea, in almost bare places, or in bare places amongst short grasses, locally common, 20-6-1932, *Sprague and Hubbard*; Freshwater Gate, cornfield, c. 1830, *Tyacke*; Freshwater, 27-6-1919, *Britten and Groves*.

WARWICKSHIRE: Kenilworth, on waste ground near the skin yards, 27-7-1902, *Jackson*.

CHESHIRE: Birkenhead, on ballast, 18-7-1876, *Burton*.

GLAMORGAN: Cardiff Docks, July 1904, *Druce*.

Pholiurus incurvus is usually regarded as adventive in this country, and the last three localities listed above, and probably also that of Langenhoe in Essex, certainly give support to that theory. In other localities, from north-west Norfolk

to the Isle of Wight, there is strong evidence that this grass is a native plant. On three occasions it has been collected with *Pholiurus filiformis* (Roth) Schinz & Thellung (*Lepturus filiformis* Trin.), or at least found in the same gathering with that species. In Norfolk and in the Isle of Wight, where it was associated with typical maritime species, it had every appearance of being a native plant. *P. incurvus* may be distinguished from *P. filiformis* by its spreading or ascending habit, mostly shorter culms, curved and usually shorter rigid spikes, and especially by the very small anthers which are 0.5–1 mm. long. In *P. filiformis* the culms are usually taller and more erect, the spikes elongated and mostly straight, whilst the anthers vary from 2–3 mm. in length.

The use of the specific epithet *incurva* for this grass requires some explanation. *Aegilops incurva* L., on which *Pholiurus incurvus* was based, was described by Linnaeus as follows:— '*Aegilops spica subulata mutica incurva. Habitat in Oriente. Tournefort*'. The very brief descriptive phrase would apply well to the specimens enumerated above, but unfortunately there is no specimen from Tournefort named by Linnaeus in the latter's herbarium with which our plants may be compared. There are, however, in the cover of *Aegilops*, two specimens labelled *incurva*, neither of which agrees with Linnaeus's diagnosis. One, written up '5 *incurva*', is *Ophiuros cochinchinensis* (Lour.) Merrill, an eastern Asiatic species, whilst the other is *Lepturus cylindricus* (Willd.) Trin. of the Mediterranean Region. It appears very probable that the first-named specimen is the plant which was collected near Canton by Osbeck on Sept. 12th, 1751, and recorded by him as *Nardus articulata* (see Osbeck, Voy. Engl. ed. i, 346; 1771). *Nardus articulata* L. Sp. Pl. ed. 1, 53 (1753), is an imperfectly known species. There is no named specimen in the Linnaean Herbarium, so that in the interpretation of this species one has to consider the brief description, synonyms, and distribution. An examination of the synonyms shows that they refer to *Pholiurus filiformis* (Roth) Schinz & Thellung, *P. incurvus* (L.) Schinz & Thellung, and *Lepturus cylindricus* (Willd.) Trin. The description and distribution would apply equally well to any of these species. In the Syst. Nat. ed. 10, ii, 1307 (1759), Linnaeus refers *Nardus articulata* to *Aegilops incurva*. Later, in the second edition of the 'Species Plantarum', neither *Aegilops incurva* nor *Nardus articulata* is to be found. Their place is taken by *Aegilops incurvata* (Sp. Pl. ed. 2, 1490; 1763), under which appears the brief (emended) description of *A. incurva* and the synonyms of *Nardus articulata*. Thus *Aegilops incurvata* L., the basis of both *Lepturus incurvatus* Trin. and *Pholiurus incurvatus* Hitchc., is a collective species, but the specific epithet applies better to *Pholiurus*

incurvus, than to the other two species. It should be noted also that Linnaeus probably intended it to apply to the species listed above as *P. incurvus*, as the two specimens named [*Aegilops*] '*incurvata*' in the Linnean Herbarium represent that species.

The genus *Pholiurus* Trin. may be distinguished from *Lepturus* R. Br. by the fact that both glumes are developed and placed laterally side by side, whereas in *Lepturus* R. Br. only one glume is developed and this is opposite the excavation in the rhachis. The species of *Pholiurus* Trin. have been referred to *Lepturus* R. Br (1810) by many authors, who, on the other hand, have referred the type of that genus, *L. repens* (Forst.) R. Br., to *Monerma* Beauv. (1812).

PROCEEDINGS OF THE LINNEAN SOCIETY

(1935-6)

CONTENTS OF PART I.

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Scientific results of the Cambridge Expedition to the East African lakes, 1930-1.—No. 15. The fish of Lake Rudolf and Lake Baringo. By Dr. E. B. WORTHINGTON, F.L.S., and C. K. RICARDO. [Abstract.]	2
Plant collecting in Fiji. By Dr. A. C. SMITH	5
Along the Linyanti River. By EDITH L. STEPHENS, F.L.S....	9
An appeal for assistance in the study of Lepidopterous Parasites. By D. S. WILKINSON, F.R.E.S.	10
The Seasons in a Tropical Rain-forest.—Parts 1 & 2. By Dr. J. R. BAKER. [Abstract.].....	12
The occurrence of the Chimpanzee in Tanganyika Territory. By Capt. GUY DOLLMAN, F.L.S.	15
Studies in Linnaean synonymy. 1. Caspar Bauhin's 'Pinax' and Burser's herbarium. By S. SAVAGE, F.L.S.	16
Cosmic rays and the origin of species. By Dr. H. HAMSHAW THOMAS, M.B.E., F.R.S., F.L.S.	26
Changes in the British Fauna and Flora during the past fifty years.—Mammals. By M. A. C. HINTON, F.R.S., F.L.S.—Birds. By N. B. KINNEAR, F.L.S.—Insects. By Dr. K. G. BLAIR.—Flowering Plants. By A. J. WILMOTT, F.L.S.—Marine Algae. By A. D. COTTON, O.B.E., F.L.S.—Fungi. By J. RAMSBOTTOM, O.B.E., Sec. L.S.....	33
Proceedings of General Meetings held on 24 October, 7 November, 21 November, and 5 December, 1935.	

